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IDA MEMORANDUM REPORT M-519
ATCCIS Working Paper 25

TECHNICAL STANDARDS FOR THE ATCCIS ARCHITECTURE

Edition 1

L. B. Scheiber, *Project Leader*

September 1988

Prepared for
Office of the Assistant Secretary of Defense (C^3I)
(Theater and Tactical Command, Control and Communications)
and
Office of the Director of Information Systems for C^4,
Headquarters Department of the Army

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IDA Log No. HQ 88-33784

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SECURITY CLASSIFICATION OF THIS PAGE

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REPORT DOCUMENTATION PAGE

1a. REPORT SECURITY CLASSIFICATION UNCLASSIFIED	1b. RESTRICTIVE MARKINGS
2a. SECURITY CLASSIFICATION AUTHORITY	3. DISTRIBUTION/AVAILABILITY OF REPORT Public release/unlimited distribution. ~~Approval must be obtained from Director for Freedom of Information and Security Review, Room 2C757, Pentagon~~.
2b. DECLASSIFICATION/DOWNGRADING SCHEDULE N/A	
4. PERFORMING ORGANIZATION REPORT NUMBER (S) IDA Memorandum Report M-519	5. MONITORING ORGANIZATION REPORT NUMBER (S)
6a. NAME OF PERFORMING ORGANIZATION Institute for Defense Analyses 6b. OFFICE SYMBOL (If applicable)	7a. NAME OF MONITORING ORGANIZATION DoD - IDA Management Office
6c. ADDRESS (City, State, and Zip Code) 1801 North Beauregard Street Alexandria, Virginia 22311-1772	7b. ADDRESS (CITY, STATE, AND ZIP CODE) 1801 North Beauregard Street Alexandria, Virginia 22311-1772
8a. NAME OF FUNDING/SPONSORING ORGANIZATION ASD (C3I) 8b. OFFICE SYMBOL (If applicable)	9. PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER MDA 903 84-C-0031
8c. ADDRESS (City, State, and Zip Code) Room 3D174 The Pentagon, Washington, D.C. 20301	10. SOURCE OF FUNDING NUMBERS PROGRAM ELEMENT: / PROJECT NO.: / TASK NO.: T-J1-246 / ACCESSION NO. WORK UNIT:

11. TITLE (Include Security Classification)
Technical Standards for the ATCCIS Architecture (U), ATCCIS Working Paper 25

12. PERSONAL AUTHOR (S).
L.B. Scheiber, J.W. Barnett, R.P. Walker

13. TYPE OF REPORT	13b. TIME COVERED	14. DATE OF REPORT (Year, Month, Day)	15. PAGE COUNT
Final	FROM ______ TO ______	September 1988	131

16. SUPPLEMENTARY NOTATION

17. COSATI CODES			18. SUBJECT TERMS (Continue on reverse if necessary and identify by block number)
FIELD	GROUP	SUB-GROUP	Army, Tactical Command and Control, Interoperability, NATO, SHAPE, Open Systems Interconnection, Portability, Standards, GOSIP, Stacks, Options, Assessment, Data Communications, Data Transmission.

19. ABSTRACT (Continue on reverse if necessary and identify by block number)

This Memorandum Report is a reprint of a document prepared by IDA in support of the SHAPE-sponsored Army Tactical Command and Control Information System (ATCCIS) Phase II study effort. ATCCIS is a common army command and control system concept for the year 2000 and beyond. This report describes a methodology, using interoperability parameters, for identifying the technical standards that will be required to support implementations of the ATCCIS architecture and for assessing the degree to which existing and emerging international standards support ATCCIS requirements. Overviews are given of standards that have been recommended for NATO's Quadrilateral Interoperability Program, STAMINA, NATO's Air Command and Control System, UK GOSIP, US GOSIP, and several applications portability profiles. The methodology described in this report is intended to be a framework for addressing interoperability questions such as: is there adequate standards coverage, are there significant overlaps among standards, and how can standards be used to ensure interoperability.

20. DISTRIBUTION/AVAILABILITY OF ABSTRACT ☐ UNCLASSIFIED/UNLIMITED ☒ SAME AS RPT. ☐ DTIC USERS	21. ABSTRACT SECURITY CLASSIFICATION UNCLASSIFIED
22a. NAME OF RESPONSIBLE INDIVIDUAL	22b. TELEPHONE (Include Area Code) / 22c. OFFICE SYMBOL

DD FORM 1473. 84 MAR — 83 APR edition may be used until exhausted. All other editions are obsolete

SECURITY CLASSIFICATION OF THIS PAGE

UNCLASSIFIED

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Contract MDA 903 84 C 0031
Task T-J1-246

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FOREWORD

(U) The purpose of this report is to make available substantive work done in response to a major interactive technical support activity. Specifically, this Memorandum Report[1] is a reprint of a document prepared by the Institute for Defense Analyses (IDA) in support of the SHAPE-sponsored Army Tactical Command and Control Information System (ATCCIS) Phase II study effort. The contents of this document were developed and agreed to in the international ATCCIS forum and, consequently, were not subjected to the normal IDA technical review process. SHAPE has distributed ATCCIS Working Paper 25 to those NATO nations and agencies that have expressed an interest in the ATCCIS study.

(U) This is Edition 1 of the working paper. Additional data and analyses will be required to complete the assessments of options and standards coverage and to extend the interoperability parameter methodology. The document is being provided at this stage of development at the request of the U.S. Representative to the ATCCIS Permanent Working Group (PWG) in order to: (1) inform people as to the progress of this SHAPE support activity, (2) provide information to people involved in interoperability activities, and (3) invite comments and additional information. Background information relating to the overall ATCCIS effort is contained in the Preface of this report. It should be noted that Oxford English spelling conventions are used throughout the report in accordance with standing NATO guidelines.

(U) The Office of the Director of Information Systems for Command, Control, Communications, and Computers, Headquarters Department of the Army, provides the U.S. delegate to the ATCCIS PWG, which consists of military, technical, and analytical representatives from France, Germany, the United Kingdom, the United States, SHAPE, Allied Forces Central Europe (AFCENT), and SHAPE Technical Center. The C^3I Directorate, U.S. Army Combined Arms Combat Development Activity, provides military expertise; the U.S. Army Communications-Electronics Command and IDA provide technical

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1 (U) This document was prepared in response to a request from the Office of the Assistant Secretary of Defense (C^3I), Theater and Tactical Command, Control, and Communications under Contract MDA 903 84-C-0031, Task Order T-J1-246, UNCLASSIFIED.

expertise; and IDA provides analytical expertise in support of the U.S. contributions to the overall ATCCIS effort. Further details concerning the ATCCIS Phase II study can be found in the ATCCIS Work Plan.[2]

(U) This report should be of primary interest to those Commands and Agencies whose focus is on the technical aspects of longer-term command and control requirements. ATCCIS Working Paper 25 was reviewed by a panel of field-grade officers and senior scientists representing SHAPE, AFCENT, France, Germany, the United Kingdom, and the United States prior to its distribution by SHAPE. Comments from NATO and National Commands and agencies have been solicited and will be incorporated into a final edition scheduled for later publication.

2 (U) *ATCCIS Phase II Work Plan*, Edition 2, IDA Memorandum Report M-263, September 1986, UNCLASSIFIED.

PREFACE

1. (U) In 1978, NATO's Long-Term Defense Plan (LTDP) Task Force on Command and Control (C2) recommended that an analysis be undertaken to determine if the future tactical Automatic Data Processing (ADP) requirements of the nations, including that of interoperability, could be obtained at a significantly reduced cost when compared with the approach that had been adopted in the past. The Task Force also recommended that the analysis should determine whether tactical ADP systems could be developed according to technical standards prescribed by NATO and agreed upon by the nations.

2. (U) In early 1980 the then Deputy Supreme Allied Commander Europe initiated a study to investigate the possibilities of implementing the Task Force's recommendations. Three nations, those with experience in fielding automated tactical command and control information systems, participated in Phase I of the study, with Supreme Headquarters Allied Powers Europe (SHAPE) as leader and coordinator. The study group reported, at the end of Phase I, that the nations could increase interoperability and potentially reduce costs by using a common development approach. It was also recommended that Phase II, the definition of an operational and technical concept and an analysis of the likely impact of a common Central Region (CR) (tactical) command and control information system, should be initiated.

3. (U) The ATCCIS study, under the direction of a steering group chaired by SHAPE and consisting of representatives from the CR nations and Allied Forces Central Europe (AFCENT), was established in 1984. Concurrently, a permanent working group (PWG) was formed which consists of military, technical, and analytical representatives from France, Germany, the United Kingdom, the United States, SHAPE and AFCENT, and technical support from SHAPE Technical Centre (STC) to progress the Phase II effort. The Phase II study effort commenced in January 1985.

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CONTENTS

ATCCIS Working Paper 25

TECHNICAL STANDARDS FOR THE ATCCIS ARCHITECTURE

1. INTRODUCTION

1.1 Derivation

(U) This paper derives from Working Papers (WPs) 22, 23, and 24 [Ref. 1-3]. WP 22 defines the basic concepts necessary for the definition of the architecture for the Army Tactical Command and Control Information System (ATCCIS), a common army command and control system concept for the year 2000 and beyond. WP 23 defines the ATCCIS services needed to meet the imposed military requirements. WP 24 specifies an architecture designed to satisfy the ATCCIS operational requirements.

1.2 Purpose

(U) The purpose of this working paper is to identify the technical standards that will be required to support implementations of the ATCCIS architecture. In this working paper, existing and planned standards, appropriate to the ATCCIS facilities, are surveyed to the level of detail necessary to confirm a reasonable basis for the future support of the ATCCIS requirements. Relevant standards are identified, but no recommendations for selecting standards are considered. Gaps in current and planned standards coverage, which may require some developmental effort, are identified and will be passed to the appropriate standards defining body within NATO. WP 25 also offers guidance in ensuring adequate coverage by the set of standards employed at the time of implementation.

1.3 Scope

(U) This working paper presents information and analyses which are intended to support implementation of the ATCCIS architecture, especially of that minimum part of ATCCIS functionality called Basic Interoperability (defined in WP 23). It provides a broad overview of the existing and developing technical standards applicable to ATCCIS.

(U) The scope of the analysis of standards that is the focal point of this paper is broad, extending to international and national, commercial and military standards.

However, the emphasis is on international commercial standards with military enhancements.

1.4 Structure of the Paper

(U) Chapter 2 describes the methodology employed to identify and analyze standards relevant to ATCCIS. Chapter 3 provides an overview of the assessment and includes a description of the reference model for open systems interconnection that is the basis for most of the current international commercial standards activities. Analyses of the applicable standards for the four facilities that make up the Basic Ensemble for ATCCIS are presented in Chapters 4-7, respectively. In Chapter 8, the results of Chapters 4-7 are compared with plans for some near-term transition strategies to achieve interoperability through specification of standards. Conclusions and recommendations of this study are given in Chapter 9.

2. METHODOLOGY

2.1 General

(U) This chapter describes the methodology employed to identify the group of existing and planned standards required to support ATCCIS functionality; and to assess the completeness of standards coverage for the time period of ATCCIS implementation. The methodology is illustrated in Figure 1.

(U) WP 24 identifies the ATCCIS architecture in terms of facilities whose combined functionality fulfills the ATCCIS operational requirements. The Basic Ensemble, which provides the minimum required operational capability (called Basic Interoperability), is composed of four facilities: the Transfer Facility (TF), the Service Control Facility (SCF), the Data Management Facility (DMF), and the System Management Facility (SMF). Each of these facilities is analyzed individually in subsequent chapters.

(U) Basic Interoperability is the capability to allow two systems to exchange data and to preserve the meaning and relationships of the data exchanged. The ATCCIS architecture will be defined by adopting existing or emerging standards wherever and whenever possible. Further, where such a standard cannot be found, ATCCIS will identify the requirement for a standard to be developed and will pass such a requirement to the appropriate standards defining body within NATO. Each facility in the ATCCIS architecture is a logical entity that provides a set of related services; implementation of a facility is not defined by the architecture and is a national responsibility for each system. This paper will identify standards (and options within standards) that are applicable to each facility, but the paper will not recommend any specific standard or groups of standards. Selection of appropriate standards, as well as the basic design choices implicit in the standards and options within standards, will be made by agreement prior to implementation decisions.

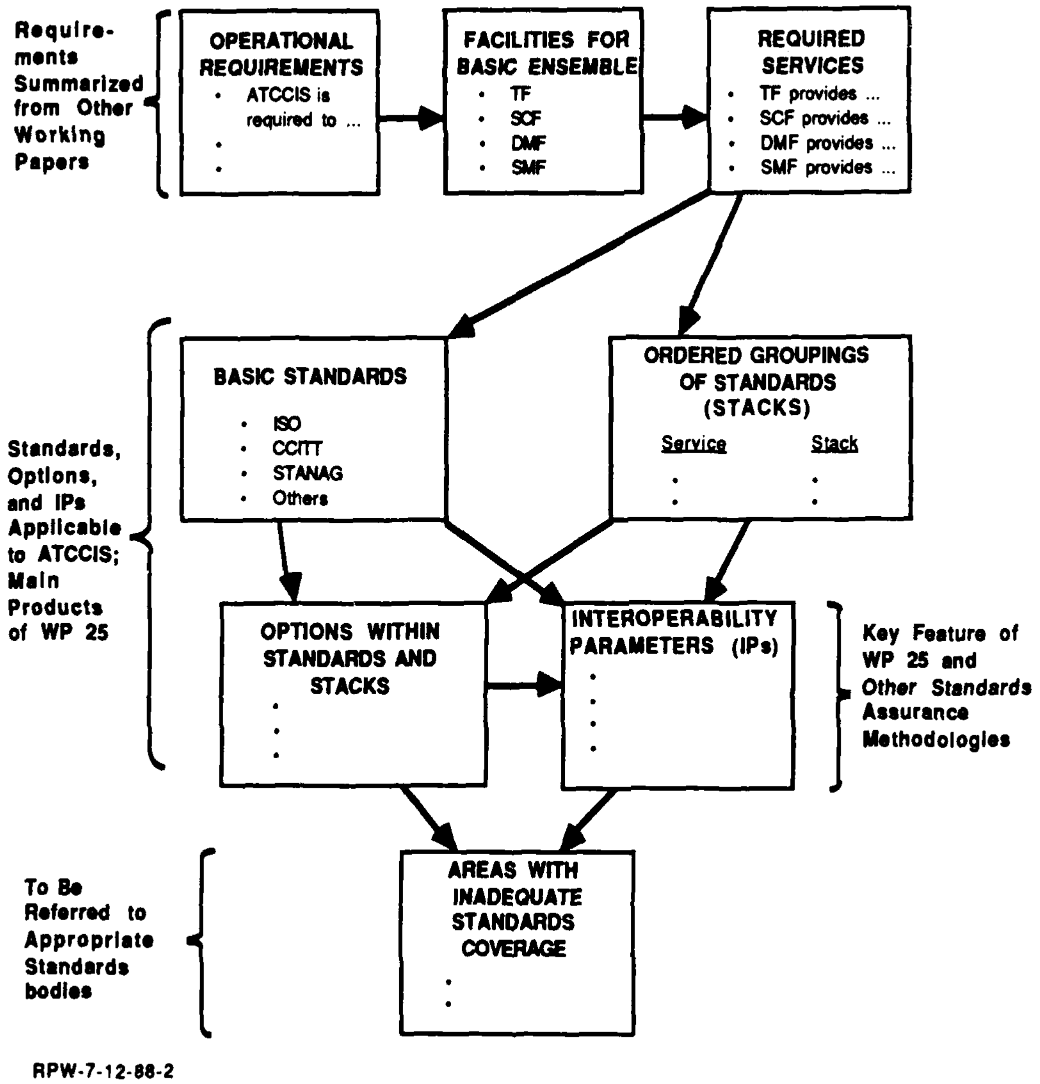

Figure 1. (U) Overview of the Methodology

2.2 Identification of Base Standards

(U) Following a review of the required services for each facility, the next step is to identify the base standards appropriate for that facility. These standards may come from international, NATO, national military or national non-military standards bodies, and they may be existing or planned. High-level options within standards applicable to ATCCIS will be identified.

(U) For many functions, there are several interrelated standards which must be used together to provide the required services. In most cases, there is an order or hierarchy among these standards, in which the lower levels are closer to physical means and higher levels are associated with applications independent of the physical means. An ordered grouping of standards is called a stack. Where applicable to services required by ATCCIS, stacks will be constructed and illustrated in tables or figures.

2.3 Assurance of Coverage

(U) Assurance of adequate standards coverage is addressed in three ways. First, WP 25 checks for the existence of standards that generally support each specific ATCCIS functionality. Requirements for which no existing or planned standard seems to exist, or for which existing standards do not seem to be adequate, are identified so that these needs may be referred to the appropriate NATO standards defining body.

(U) On a more specific level, a methodology for assuring adequate standards coverage through detailed analysis has been developed. An Interoperability Parameter (IP) approach is defined that begins with the identification of the system design parameters whose control is required to achieve interoperability. The assembled parameters act as a checklist for interoperability, since each IP must be controlled by a suitable standard. The purpose of an analysis using IPs is to recognize and examine all relevant quantities and characteristics in a direct manner, instead of assuming that existing or draft standards will provide adequate coverage of the quantities. Appendix A will discuss this approach in more detail.

(U) In the third step of the coverage analysis (see Chapter 8), the array of standards selected to support ATCCIS is compared with plans for near-term efforts to check for completeness. Near-term efforts include NATO interoperability demonstrations, such as the Quadrilateral Interface Committee; standards and stacks recommended by several national agencies, such as government open systems interconnection profiles (GOSIP), and applications portability profiles recommended by international consortiums such as X/OPEN. In addition to providing a check on completeness of ATCCIS applicable standards, some of these near-term efforts are of interest because they represent transition strategies for moving to open environments for information processing and exchange.

3. OVERVIEW OF THE ASSESSMENT

3.1 Introduction

(U) One of the underlying principles for the ATCCIS concept is that specifying standards is essential to ensuring interoperability. However, it cannot be too strongly emphasized that specifying standards alone will not guarantee interoperability. Indeed, every standard has a number of system and design parameters or IPs whose values may need to be fixed in the design phase of implementation. To ensure interoperability, each of these IPs must also be specified and controlled. Some IPs are very general and may be used to specify a class of options or mode of operation. Other IPs may be very detailed, such as restrictions on timing, format size, or bandwidth.

(U) Because each standard is a reflection of the degree to which agreement can be reached in a service area, many important attributes (i.e., IPs) are often left unspecified or unaddressed. As agreements are reached over time, the standards will improve by addressing more functionality and harmonizing conflicting approaches. In cases where standards identify extensions and other types of options, great care must be taken in standards specification and IP control to ensure that, whenever an extension or option is permitted, every implementation of the related service also supports this extension or option. This principle is especially important in achieving not only interoperability but also portability of applications from one implementation or environment to another, such as is needed when operating systems, data management systems, interface packages, and hardware are upgraded.

(U) There are three major classes of standards applicable to ATCCIS:

- Standards for bearer circuits
- Standards for open systems interconnection (OSI)
- Standards for higher level applications and data representation.

The classes are shown in Figure 2. IPs will be drawn from all three classes of standards, from both minimum requirements and options with the standards. As will be shown in subsequent chapters, the Transfer Facility requires standards in the first two classes, whereas the other three facilities in the Basic Ensemble (SCF, DMF, and SMF) are addressed primarily by standards for higher level applications and data representation. One of the layers of OSI standards (the application or highest layer) has standards not only for the TF but also for the other three facilities. Although not indicated in Figure 2, there is potentially an overlap among the standards applicable for the TF and those for the other facilities. Further, Figure 2 does not explicitly identify higher-level functional or military applications that may be implemented by some or all of the ATCCIS components and that go beyond Basic Interoperability. Whenever possible, diagrams such as the one inFigure 2 will be provided to show which standards are required for each of the applicable service options, and the service options will be identified at the bottom of the diagram. Ordered groupings or stacks of standards for a particular service will also be shown by connecting blocks of standards with solid vertical lines.

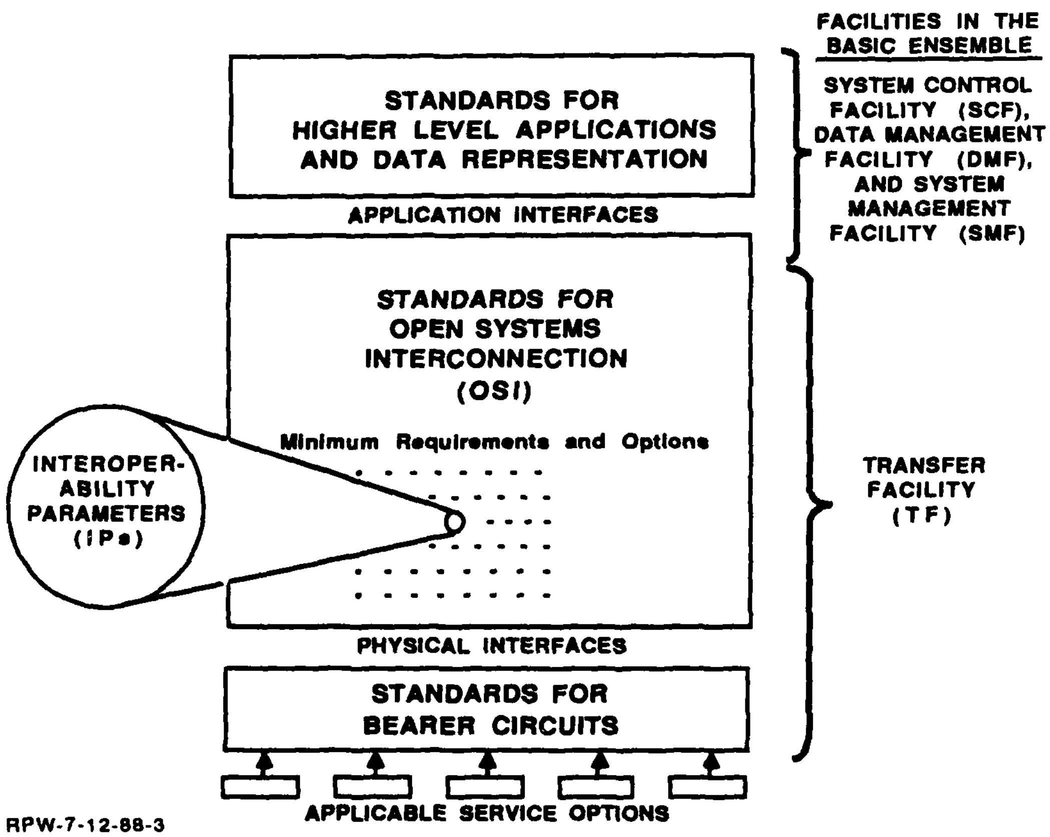

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Figure 2. (U) Classes of Standards and Their Relation to ATCCIS Facilities

3.2 Relationship of ATCCIS Facilities to OSI Layers

(U) The first step of the analysis consists of the classification of the facility of interest in terms of the open systems interconnection (OSI) model developed by the International Standardization Organization (ISO). In this model, the functions required for interoperation between data processing systems are divided into seven layers (Figure 3). Layers 1-4 are called the lower layers and are primarily concerned with control of the data transmitted between data processing systems. The Physical Layer (Layer 1) controls data transmission over physical media (e.g., wire). The Data Link layer (Layer 2) augments the Physical Layer function by providing transmission error control along segments of the transmission network. The Network Layer (Layer 3) controls the data transmission route. The Transport Layer (Layer 4) provides protocols for moving data between end systems on the network.

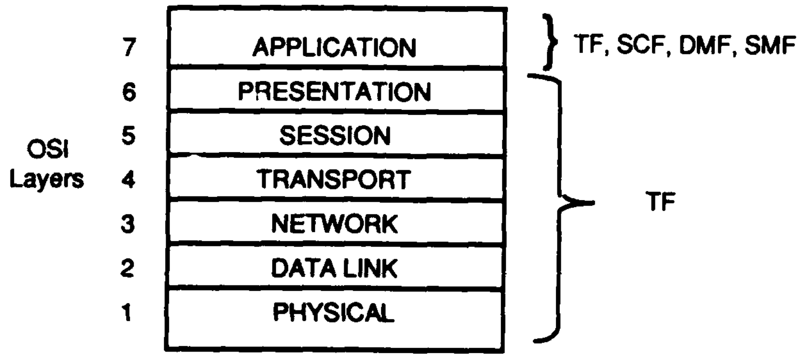

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Figure 3. (U) The Seven-Layer Model for Open Systems Interconnection

(U) Layers 5-7 are called the upper layers and are concerned with the network's interface to the end systems. The Session Layer (Layer 5) establishes a logical connection between communicating end systems. The Presentation Layer (Layer 6) ensures that data from the network is presented to the user in an intelligible form. The Application Layer (Layer 7) provides the application programs which may request services from other systems on the network in order to complete their user-dictated tasks.

3.2.1 Basic Options in OSI Standards

(U) Options for international standards that support the OSI model are designated by grouping the OSI layers into two classes: application options and transport options (Figure 4). Following Reference 4, the combined layers 5-7 will be considered to offer application options, while layers 1-4 offer transport options. A separate category of relay options that provide interfaces between subnetworks will also be considered. Relay options normally are provided by layers 1-3 (Figure 5).

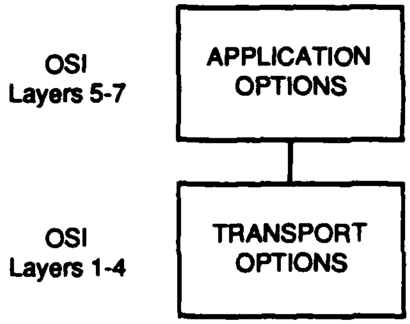

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Figure 4. (U) Composition of an OSI System

(U) The major application, transport, and relay options are listed in Table 1. The ATCCIS PWG has determined that, of these options, the Virtual Terminal Service (VTS) and the Job Transfer and Manipulation (JTM), listed under Basic Application Options, are not relevant to ATCCIS. (VTS would provide a capability to simultaneously perform batch and interactive processing. JTM would permit one component to task another component to perform data processing normally conducted only at the first component.) These two services have been determined as not appropriate between national headquarters, but could be implemented as a national prerogative. The two services will not be considered further in this paper. The remaining basic options are briefly described in the following paragraphs.

3.2.2 Connection-Oriented and Connectionless-Oriented Transmission Modes

(U) One of the important issues which must be considered when reviewing OSI standards is the choice between connection-oriented (CO) and connectionless-oriented (CL) services. Each of the seven OSI layers, except the physical layer, may be CO or CL. (The physical layer is inherently connection oriented.) ISO reference model mandates that theupper four layers must all be CO or all be CL. The following paragraphs, based on References 5-7, address some prominent distinctions between these two classes of services.

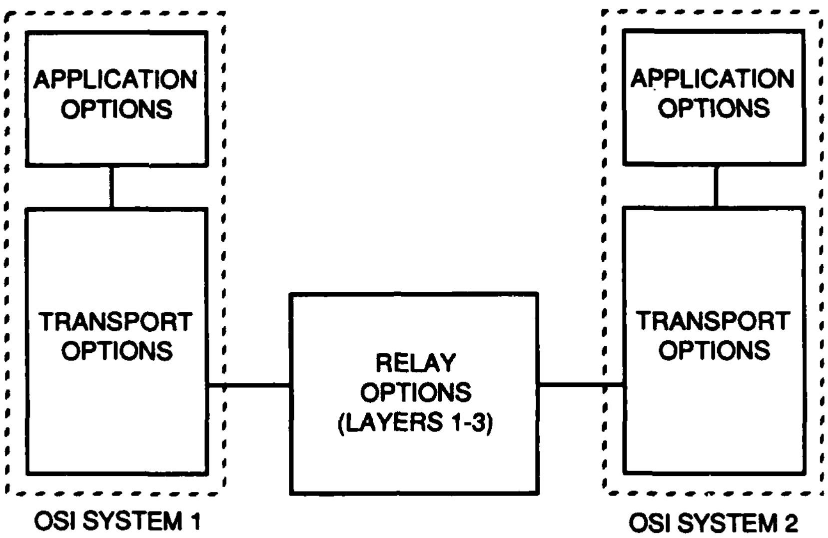

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Figure 5. (U) The Role of a Relay

(U) The basic difference between CO and CL service is that CO service requires an explicit relationship to be established between the interacting peer entities, while in CL service no such explicit relationship occurs. In CO service the relationship may be real, such as a dedicated circuit, or virtual, such as a particular path from node to node between peer entities as is encountered in a CO packet-switched service. In the latter case the path would be agreed upon before data transfer begins and would remain unchanged during the transfer. A heuristic example of CO service is the U.S. public telephone service; the regular delivery postal service is a heuristic example of a CL service (delivery of a parcel to a mail box or address rather than a person). In CO service, there is the possibility of error checking and retransmission of data packets known to be in error, at the cost of some amount of overhead for each packet. X.25 switched protocols are connection oriented.

Table 1. (U) Application, Transport, and Relay Options Offered by OSI Standards

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BASIC APPLICATION OPTIONS

- Primary Services:
  - Message Handling:
    - Message Handling Service (MHS)
    - Message-Oriented Text Interchange System (MOTIS)
  - File Transfer Access and Management (FTAM)
  - Telematic Services (TELETEX, TELEFAX, TEXTFAX)
  - Virtual Terminal Service (VTS)
  - Job Transfer and Manipulation (JTM)
- Other Services:
  - Directory
  - Transaction Processing (TP)
  - Open Distributed Processing (ODP)
  - Remote Data Access (RDA)
  - OSI Management
- Transmission Mode:
  - Connection Oriented (CO)
  - Connectionless (CL)

BASIC TRANSPORT OPTIONS

- Subnetwork Type:
  - Local Area Network (LAN)
  - Dedicated Line
  - Switched Telephone Network (STN)
  - Packet Switched Data Network (PSDN)
  - Circuit Switched Data Network (CSDN)
  - Integrated Services Digital Network (ISDN)
- Transmission Modes:
  - Connection Oriented
  - Connectionless
- Transmission Media Interfaces:
  - Wire
  - Radio
  - Fiber Optic Cable
  - Microwave
  - Infrared

BASIC RELAY OPTIONS

- LAN to LAN
- LAN to Wide Area Network (WAN)
- WAN to WAN
- LAN to WAN to LAN

(U) CO service has three phases: connection establishment, data transfer, and connection release. The CO explicit relationship is established during the negotiation phase and before the transfer phase. CO service provides for negotiation of the form of transmitted data, and may maintain sequence and flow control. Error handling may also be supported. The overhead invested in a CO connection pays off when the data transfer phase is relatively long.

(U) In contrast, CL service has only one phase, namely, data transfer. The form of data transferred must be pre-arranged between peer entities. Sequencing, flow control, and error handling are not supported by the CL service, but are instead the responsibility of the interacting peer entities. Sometimes referred to as a "datagram" service, CL service requires each data unit to be self-contained; there is no relationship between a given data unit and any previous data unit.

(U) While each of the six highest OSI layers may be CO or CL, crossover between the two types of service may occur only at the network layer (layer 3). Specifically, the connection orientation of the application layer (layer 7) must agree with the connection orientation of layers 4, 5, and 6. Further, the connection orientation of layers 2 and 3 must also agree, but this orientation may differ from that of the higher layers.

(U) The many resulting combinations of service are useful in different circumstances. In general, CO service is beneficial when long-lived connections with extensive data transfer are anticipated. File Transfer, Access, and Management (FTAM) is an example of an application which would likely benefit from a CO connection. However, for military applications which require robust networks capable of continuing data transfer even as some nodes are taken out of service, CL service may be appropriate, especially for the lower layers (network and data link). References 5 and 7 give some additional examples of cases for which CL service is appropriate, even for the upper layers. Included are: inward data collection from the sampling of data sources, broadcast messages, some distributed transactions, some real-time transmission applications, and cases in which one or more communicating peers are mobile.

(U) The cases in which the six layers 2 through 7 are all either CO or CL are more straightforward than cases with upper and lower layers of different orientation. If CL upper layers operate over CO lower layers, the full functionality of the lower layers is not employed; the application in this case does not enjoy the amenities of CO service.

(U) The OSI standards supporting CO service were the first to be developed and are nearly complete. Standards supporting the lower layer CL service are more advanced than those supporting upper layer CL services. Specifically, CL protocols for the transport layer have recently been finalized (ISO 8602, June 1987). Draft standards for CL protocols for the session and presentation layers have been circulated for comment: DIS 9548 (May 1988) and DP 9576 (April 1988), respectively.

4. THE TRANSFER FACILITY (TF)

4.1 Description of the TF

(U) As defined in WP 24, the TF is the logical entity in the Basic Ensemble that binds together all ensembles[1] in ATCCIS. As such, it supports the transmission of service requests between ensembles.

(U) The ATCCIS architecture is shown in Figure 6. It shows the relationship between the TF and the other three facilities in a Basic Ensemble. The Basic Ensemble is highlighted with bold lines. Application facilities (not required for an ensemble), which provide functional support to the users on top of Basic Interoperability, are included in Other Facilities.

(U) Figure 6 shows that the SMF, SCF, and DMF each appear in all the ensembles, whereas the TF is considered to be a facility that extends across all the ensembles. Ensembles A and B can be thought of as the facilities at two physical locations in two ATCCIS components. The TF not only includes the services for open systems interconnection but also includes the services for the bearer circuits (e.g., communications media). The services of the bearer circuits are depicted in Figure 6 as the portion of the TF that connects Ensembles A and B.

(U) TF provides a variety of services for transferring data from one component to another. Some of these services are necessarily defined [WP 24d] by reference to international standards, such as the standards for MHS. In these cases, the specification of TF does not indicate the services to be provided, but will point to the appropriate standard.

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1 (U) An ensemble is [WP 24] a set of standard facilities that includes, as a minimum, the four basic facilities (TF, SCF, DMF, and SMF). An ensemble is a logical entity that will be implemented on an ATCCIS component and thus has the intrinsic property of being associated with a location. Only one ensemble can be implemented on any one ATCCIS component.

(U) Three additional services have been identified that are not presently part of any international standard. These are:

- Send--Allows a service requestor to send a request to a service provider at another ensemble
- Query--Allows a service requestor to interrogate TF in order to get the status of a previously submitted Send service request (possibly a chainable service)
- Cancel--Allows a service requestor to stop further delivery or servicing of a previously sent service request.

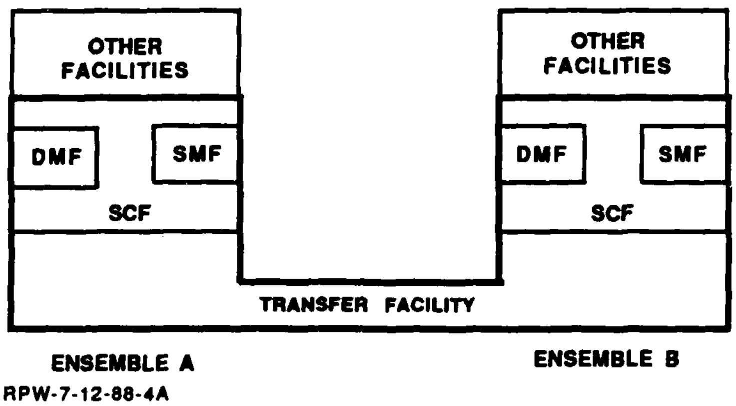

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Figure 6. (U) Facilities of the ATCCIS Architecture

4.2 Standards Activities and Emerging Standards

(U) This section begins with a description of the base standards that have been defined for the OSI seven-layer model. Stacks of base standards are described separately for application options, transport options, and relay options. This is followed by a description of two related sets of standards that are emerging, one for OSI management and one for directory services.

4.2.1 Base Standards and Stacks of Base Standards

(U) This section identifies the OSI standards that are relevant to the TF. (A compilation of international standards relevant to ATCCIS, complete with full titles and sorted by ISO layer, is given in Appendix B. Appendix C contains a numerical listing of ISO standards with titles, dates, and status.) Table 1 (above) identified OSI options applicable to ATCCIS, and these are all relevant to the TF. The most useful form in which to present the specific standards that support OSI options is ordered groupings (called stacks) to show their application to specific interfaces and services. Tables 2, 3, and 4 identify stacks for application options, transport options, and relay options, respectively. The relationship among these three classes of options was described in Figure 5. The stacks are taken primarily from the recommendations of TSGCEE Subgroup 9 [Ref. 4]. The standards include CCITT recommendations (e.g, T.60, X.402, V.24) and ISO standards: DIS denotes an ISO draft international standard, and DP an ISO draft proposal.

(U) Of the possible sets of transport standards for LANs providing combinations of connection (CO)-mode and connectionless (CL)-mode transport and network services, CL transport with CO network service has not yet been included in Table 3. Standards for the case of asynchronous devices (start-stop transmission) are listed under Options in the second part of Table 3, although the relevant standards (X.28 and X.29) also control OSI layers above Layer 4.

(U) Examples of possible application and transport option stacks are depicted in Figure 7. The types of transport services are identified along the bottom of the figure. Standards and options in a layer common to several stacks are shown in blocks. For example, the Logical Link Control (LLC) in Layer 2 is common to stacks for all four types of local area networks (LANs) shown in Figure 7. Above the LLC, both the Packet Level Protocol (PLP), also known as CCITT X.25, in ISO 8881 or the connectionless network protocol (CLNP) apply to each of the four LAN options. The X.25 PLP in ISO 8208 or 8878 in Layer 3 and the High-Level Data Link Control (HDLC) in Layer 2 are common to stacks for four types of circuits: Permanent Analog Circuits, Permanent Access to the Packet Switched Digital Network (PSDN), Permanent Digital Circuits, and Switched Digital Circuits. Note that all of the standards shown for the PLP and HDLC apply to the Permanent Analogue Circuit and Permanent Access to PSDN, but only a few of the standards shown for PLP and HDLC apply to Permanent Digital and Switched Digital cases. This can be seen by comparing Table 3 with the standards noted in Figure 7.

Table 2. (U) Upper-Layer Stacks of Base Standards for Application Options

UNCLASSIFIED

APPLICATION OPTION	LAYER 5	LAYER 6	LAYER 7
TELETEX	ISO 8327 T.62	T.60 T.61	T.60 T.61
TEXTFAX	ISO 8327 T.62	T.72, T.61 T.6, T.73	T.72, T.61 T.6, T.73
TELEFAX	ISO 8327 T.62	T.5, T.6 T.73	T.5, T.6 T.73
Message Handling Service (MHS-88)	ISO 8327	DIS 8823 ISO 8824 ISO 8825	DIS 10021 DIS 9066 DIS 9072 DIS 8649 DIS 8650 X.403, X.408 T.330
Message-Oriented Text Interchange System (MOTIS-88)	ISO 8327	DIS 8823 ISO 8824 ISO 8825	DIS 10021 DIS 9066 DIS 9072 DIS 8649 DIS 8650
File Transfer, Access and Management (FTAM)	ISO 8327	DIS 8823 ISO 8824 ISO 8825	DIS 8571 DIS 8649 DIS 8650
Directory	ISO 8327	DIS 8823 ISO 8824 ISO 8825	DIS 9594 X.500, X.501 X.509, X.511 X.518, X.519 X.520, X.521
Transaction Processing	ISO 8327	DIS 8823 ISO 8824 ISO 8825	DP 10026
Open Distributed Processing	ISO 8327	DIS 8823 ISO 8824 ISO 8825	?
Remote Data Access	ISO 8327	DIS 8823 ISO 8824 ISO 3825	DP 9579
OSI Management	ISO 8327	DIS 8823 ISO 8824 ISO 8825	DP 9595 DP 9596 SC21 N2863-2689 SC21 N2673, N1383

Table 3. (U) Lower-Layer Stacks of Base Standards for Transport Options

UNCLASSIFIED

TRANSPORT OPTION	LAYER 1	LAYER 2	LAYER 3	LAYER 4
Permanent Analogue Circuit	V.24 V.35 V.36 DIS 2110 ISO 2593 DIS 4902	ISO 3309 ISO 4335 ISO 7478 ISO 7776 ISO 7809 ISO 8471 ISO 8885	ISO 8208 ISO 8878	ISO 8073
Permanent Access to PSDN:				
End System	X.21 DIS 490	ISO 3309 ISO 4335 ISO 7478 ISO 7776 ISO 7809 ISO 8471 ISO 8885 X.25	ISO 8208 ISO 8878 X.25	ISO 8073
PSDN	X.25	X.25	X.25	
Permanent Digital Circuit	X.21 DIS 4903	ISO 7776	ISO 8208	ISO 8073
Switched Telephone Network (STN)	X.28	ISO 7776	ISO 8208	ISO 8073
Switched Digital Circuit:				
Call Control and Clearing Phase	X.21	X.21	X.21	N/A
Data Transfer Phase	X.21 DIS 4903	ISO 7776	ISO 8208	ISO 8073
LAN Providing CO Network Service and CO Transport Service	DIS 8802/3 or 8802/4 or 8802/5 or 8802/7	DIS 8802/2 DIS 8802/3 or 8802/4 or 8802/5 or 8802/7	DIS 8881	ISO 8073
LAN Providing CL Network Service and CO Transport Service	DIS 8802/3 or 8802/4 or 8802/5 or 8802/7	DIS 8802/2 DIS 8802/3 or 8802/4 or 8802/5 or 8802/7	DIS 8473	ISO 8073
LAN Providing CL Network Service and CL Transport Service	DIS 8802/3 or 8802/4 or 8802/5 or 8802/7	DIS 8802/2 DIS 8802/3 or 8802/4 or 8802/5 or 8802/7	DIS 8473	ISO 8602

Table 3. (U) Lower-Layer Stacks of Base Standards for Transport Options (Continued)

UNCLASSIFIED

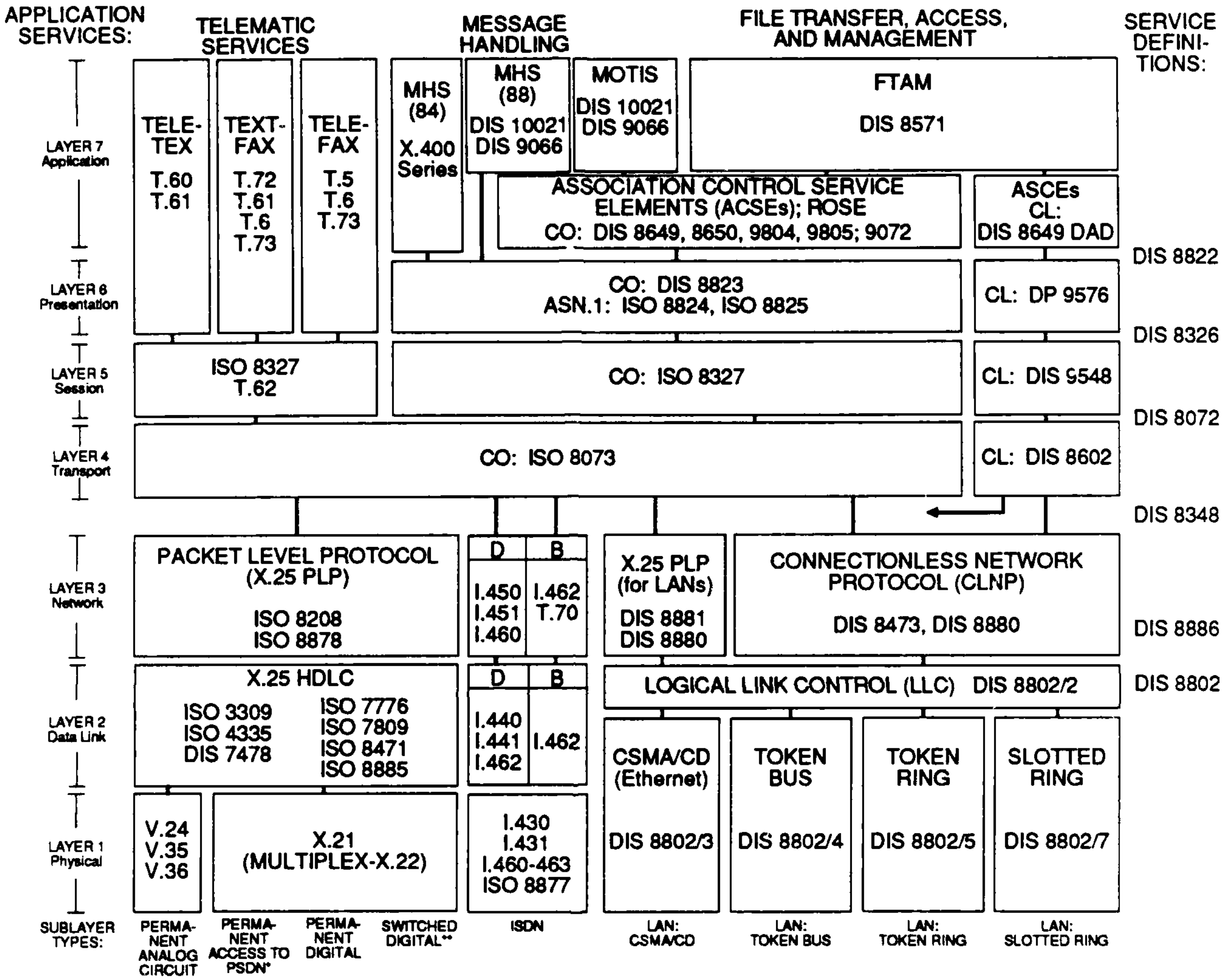
TRANSPORT OPTION	LAYER 1	LAYER 2	LAYER 3	LAYER 4
Asynchronous Devices (Start-Stop Transmission)	X.20	X.28, X.29	X.28, X.29	X.28, X.29
Integrated Services Digital Network (ISDN):				
D Service (16,000 b/s)	I.430, I.431 I.460-463 ISO 8877	I.440, I.441 I.462	I.450, I.451 I.460	ISO 8073
B Service (64,000 b/s)	I.430, I.431 I.460-463 ISO 8877	I.462	I.462 T.70	ISO 8073

Note: ISDN standards have been changed in the 1988 CCITT recommendations; new numbers need to be identified and incorporated here and elsewhere.

Table 4. (U) Stacks of Base Standards for Relay Options

UNCLASSIFIED

RELAY OPTION	LAYER 1	LAYER 2	LAYER 3
LAN to LAN:			
LAN	DIS 8802/3 or 8802/4 or 8802/5 or 8802/7	DIS 8802/2 DIS 8802/3 or 8802/4 or 8802/5 or 8802/7	DIS 8473 ISO 8208
Internetworking Service			ISO 8648
LAN to Wide Area Network (WAN) or PSDN:			
LAN	DIS 8802/3 or 8802/4 or 8802/5 or 8802/7	DIS 8802/2 DIS 8802/3 or 8802/4 or 8802/5 or 8802/7	DIS 8881
WAN	X.21 DIS 4903	X.25 ISO 7776	X.25 ISO 8208
Internetworking Service			ISO 8648
WAN (PSDN) to WAN (PSDN)	X.75	X.75	X.75
LAN to WAN to LAN:			
LAN	DIS 8802/3 or 8802/4 or 8802/5 or 8802/7	DIS 8802/2 DIS 8802/3 or 8802/4 or 8802/5 or 8802/7	DIS 8473
WAN	X.21 DIS 4903	X.25 ISO 7776	X.25 ISO 8208
Internetworking Service			ISO 8648



* End System as shown; PSDN Layers 1-3 are X.25.

** End system data transfer phase shown. For call control and clearing phase, Layers 1-3 are X.21.

RPW-7-12-88-6

Standards are CCITT unless designated ISO or DIS.
Stacks are based on TSGCEE SG9 TCIS Transition Strategy.

UNCLASSIFIED

Figure 7. (U) Stacks of Standards for Application and Transport Options

4.2.2 OSI Management

(U) The ECMA established [Ref. 24] in January 1987 an abstract model for the management aspects of OSI. The framework provided by ECMA is designed to form the basis for the definition and specification of services and protocols that enable the planning, organising, supervising, and controlling of the communication service that forms a part of a distributed information processing system. In this context, OSI management is defined as the collection and interchange of information necessary for the management of those aspects of open systems that are relevant to Open Systems Interconnection. The abstract model addresses standardization in two areas:

- Semantics of the management information transferred or extracted from the management information base (where the structure of the information within the management information base is viewed as a local matter and not subject to management standardization),
- Services and associated protocols for the transfer of management information between open systems; this requires that both the syntax and semantics of the information transferred be specified.

(U) ISO standards for Management Information System Services are IS 9595 (service definitions) and IS 9596 (protocols).

4.2.3 Directory Management

(U) CCITT is developing a database application standard for logically storing directory information. The standards are in the following X.500 Series recommendations: X.500, X.501, X.509, X.511, X.518, X.519, X.520, and X.521.

(U) SC21 WG4 is working on OSI directories. ISO standards (May 1988) for the directory are:

- DIS 9594-1, Overview of Concepts, Models, and Service
- DIS 9594-2, Models
- DIS 9594-3, Abstract Service Definition
- DIS 9594-4, Procedures for Distributed Operations
- DIS 9594-5, Protocol Specifications
- DIS 9594-6, Selected Attribute Types
- DIS 9594-7, Selected Object Classes
- DIS 9594-8, Authentication Framework.

4.2.4 Remote Operations Service Elements (ROSEs)

(U) ROSEs provide a set of communications facilities to distributed applications. The standard (DP 9072) also provides a notation for defining them (an extension of ANS.1). Remote operations service is asynchronous, so a client need not wait for a response before invoking another operation. DP 9072 defines the structure of remote operations and the abstract services and protocol to support them. The services are generic, in that their effect on the remote object is defined by their users.

(U) The basic interaction with a remote object is an operation that is similar to a procedure call in a programming language. An operation is invoked on a target object, to which the operation argument is passed. Operations have one of two possible structures, and invocations have two possible outcomes. Some operations return a Result when they are executed successfully, and an Error otherwise; other operations only produce a response (Error) if the operation fails.

4.3 Options Within the Standards

(U) In this section the major options within the selected standards are discussed. Since changing technology and continued refinements are likely to cause changes in these standards before ATCCIS is implemented, only major options are identified and analyzed to ensure that the requirements of ATCCIS will be provided by the selected standards.

(U) The standards will be addressed in the order in which they appear in Tables 2, 3, and 4.

4.3.1 Message Handling Services (MHS and MOTIS)

(U) Table 5 summarizes the set of standards which define MHS and MOTIS services. Efforts have been made by CCITT and ISO to converge Message Handling Service (MHS) and Message-Oriented Text Interchange System (MOTIS). The result, defined by standards released in 1988, is a substantially but not completely compatible set of new standards. [Balloting for the previous MOTIS standards (DIS 8505, DIS 8883, and DIS 9065) was suspended, and the scope of these standards has been incorporated in DIS 10021.] The relationship of the X.400-1984, X.400-1988, and MOTIS-1988 standards is provided in Table 5. Notice that MOTIS still has no parallel to the X.408 standards for algorithms used when converting between different types of encoded information, no parallel for the X.430 (now T.430) TELETEX access protocols, and none for X.403.

Table 5. (U) Base Standards for Message Management

UNCLASSIFIED

CCITT X.400-LAYER	MHS CCITT X.400-1984	MHS MOTIS 1988	ISO-1988
7 7	X.400 X.401	X.400 (1)	DIS 10021-1
7	N/A	X.402	DIS 10021-2
7	N/A	X.403 (2)	None
7	N/A	X.407	DIS 10021-3
7	X.408	X.408	None
7	X.409 X.209	X.208 ISO 8824 DAD1 ISO 8825 ISO 8825 DAD1	ISO 8824
7	X.410	X.218 X.219 X.228 X.229	DIS 9066-1 DIS 9072-1 DIS 9066-2 DIS 9072-2
7	X.411	X.411 X.419 (3)	DIS 10021-4 DIS 10021-6
7	N/A	X.413	DIS 10021-5
7	X.420	X.420	DIS 10021-7
7	X.430	T.330	None
7 (ASCE)	N/A	X.217 X.227	DIS 8649 DIS 8650
6	N/A	X.216 X.226	DIS 8822 DIS 8823

Notes: (1) 1988 X.400 is double-numbered with 1988 F.400.
(2) Citation for 1988 X.403 includes three manuals.
(3) 1988 X.419 and DIS 10021-6 have a wider scope than the part of 1984 X.411 and DIS 8883 that they replace.

Source: Provided by OMNICON on 8 September 1988.

(U) The standards for MHS are described and general options noted in Table 6.

4.3.2 Other Standards Options

(U) To be provided.

Table 6. (U) Message Handling Service (MHS) Analysis

UNCLASSIFIED

STANDARD	DESCRIPTION	GENERAL OPTIONS
X.400	Defines message handling services.	Interpersonal message (IPM) handling; application independent message handling.
X.401	Describes basic service elements and optional user facilities.	IPM optional user facilities per-message basis: p. 41 of standard contracted: p. 42 of standard Message transfer (MT) optional user facilities per-message basis: p. 43 of standard contracted: p. 43 of standard (Optional facilities are listed here and defined in X.400)
X.408	Encoded information type conversion rules.	Rules given for conversion from: TELEX, International Alphabetc No. 5, TELETEX, Group 3 FAX,text interchange format, Videotex, voice, simple formatted document,and text interchange format (few actually completed in 1984 X.408)
X.409	Presentation transfer syntax and notation (will be ASN.1).	(Implementation issue; no general options.)
X.410	Describes remote operations and reliable transfer server.	(Implementation; supports interactive application protocols.)
X.111	Defines MT layer service.	(Options selected in X.401).
X.420	Defines IPM layer service.	(Options selected in X.401.)
X.430	Defines teletex access protocol.	

Note: These options need to be updated to reflect the 1988 CCITT recommendations for MHS.

Source: *Data Communication Networks Message Handling Systems*, Red Book, CCITT, October 1984, UNCLASSIFIED.

4.4 Assessment of Coverage by Standards

(U) In this section, the coverage of TF requirements by the selected standards is discussed. Gaps in standards coverage are noted so that they may be referred to appropriate NATO standards defining bodies. The functional groupings of Application, Transport, and Relay are discussed in turn.

4.4.1 Application Functional Standards

(U) To be provided.

4.4.2 Transport Functional Standards

(U) To be provided.

4.4.3 Relay Functional Standards

(U) To be provided.

5. THE SERVICE CONTROL FACILITY (SCF)

5.1 Description of the SCF

(U) The SCF is defined in WP 24 [Ref. 3] to be a logical entity that binds together all the facilities in a given ensemble, together with any National Facilities which are supported by that ensemble. The SCF provides internal routing of service requests within an ensemble. The SCF augments the TF by providing information or cancellation of previously despatched service requests. There is no concept of peer interactions between SCFs.

(U) As described in WP 24b [Ref. 8], the SCF provides five basic services:

- Despatch--Allows a service requestor to send service requests to a service provider
- Query--Allows a service requestor to request information about a previously despatched service request
- Cancel--Stops delivery or servicing of a previously despatched service request
- Multiquery--Allows a privileged user to request information about more than one previously despatched service request (possibly for service requests despatched by more than one user)

- Multicancel--Allows a privileged user to stop delivery or servicing of more than one previously despatched service request (possibly for service requests despatched by more than one user).

In addition, the SCF has a registration mechanism. This mechanism may require two additional services: register and deregister.

5.2 Standards to Support the SCF

(U) The selection of standards for the SCF is more difficult than for the TF for two reasons: there are far fewer relevant international standards, and the selection of standards for the SCF, more than for the other basic facilities, is nearly an implementation issue. The SCF is outside the scope of the OSI model.

(U) In WP 24b, it is pointed out that one option for providing SCF functionality is through the selected operating system (possibly with some modifications). Potential operating system interfaces are described in the subsections that follow. Another option is to define a separate entity for the SCF; however, no standard appears to exist for such an entity, and the required services may be too ATCCIS specific to allow standards to be employed.

(U) A few specific comments may be addressed to the despatch function, which appears to be the most important SCF function. Requests for despatch may originate locally or at remote sources. Despatch of local requests may be performed by the selected operating system. If an ATCCIS-unique interface to the communication subsystem (TF) is used, the despatch of requests received through TF to a given component is performed as any other local request.

(U) Concerning the registration mechanism, it may be noted that this is implementation dependent and may not require standardization by the ATCCIS PWG.

(U) Continued analysis of standards relevant to the SCF, including the consideration of options within specific standards, is dependent on the selection of base standards (e.g., a specific operating system). The PWG considers such a selection to be implementation dependent and wishes to leave open the possibility of other implementations that are presently less standardized (e.g., the use of a bare machine with an Ada run-time environment). Further analysis of potential SCF standards would be based on further definition of standard operating systems or refinement of SCF basic service requirements.

5.2.1 POSIX

(U) The Portable Operating System Interface for Computer Environments (POSIX) is an interface standard for operating systems that is designed to be vendor independent and to promote application portability. Development of the POSIX standards is through the Institute of Electrical and Electronics Engineers (IEEE), and they has been promulgated in five draft standards, one each by the following working groups:

- IEEE-P1003.1 POSIX Standard (Draft 13 was approved as a US standard on 22 August 1988)
- IEEE-P1003.2 Shell and Tools (approval balloting planned in 1989)
- IEEE-P1003.3 Test Method Specifications (approval balloting planned in early 1989)
- IEEE-P1003.4 Real Time Extensions (schedule undetermined).
- IEEE-P1003.5 Ada Language Bindings (balloting planned for the end of 1989).

Additional IEEE-P1003 working groups have been identified:

- IEEE-P1003.0 to address P1003 guidance and strategic planning
- IEEE-P1003.6 to address security
- IEEE-P1003.x to address networking
- IEEE-P1003.y to address system administration
- IEEE-P1003.z to address FORTRAN language binding.

(U) The POSIX standard recently approved by IEEE will be offered to the international standards community. WG15 of SC22 for the Joint Technical Committee (JTC1) was formed in September 1987 and was assigned responsibility for POSIX and is expected to issue the IEEE standard as a Draft International Standard (DIS) in early 1989. Comments received on earlier drafts of POSIX by WG15 have all been incorporated. WG15 intends eventually to remove the focus on UNIX and the "C" language to create a generic interface specification between any language and a multiuser environment.

(U) The U.S. National Institute of Science and Technology (NIST, formerly the National Bureau of Standards) adopted on 31 August 1988 an early draft of POSIX (P1003.1 Draft 12) as an interim Federal Information Processing Standard (FIPS 151) and will support its adoption as an international standard. NIST developed a POSIX Conformance Test Suite (approved on 31 August 1988 and distributed with FIPS 151).

This test suite is defined in IEEE-P1003.3,[2] for use as a national and international validation service. NIST has scheduled workshops beginning in September 1988 to review the IEEE POSIX standard; adoption of the IEEE standard as a revised FIPS is expected in 1989. Thus, IEEE, ISO, and NIST will converge to a single POSIX standard by 1989.

(U) An ANSI standard for "C" language (X3J11), compatible with POSIX, is planned for late 1988 or early 1989; certified ANSI standard "C" bindings are not expected before the end of 1989. POSIX is intended to be compatible with both SQL and information resource dictionary system (IRDS) database management languages as well as with OSI data communications and interprocess communications. The IEEE "P1003" group is working on standards for a subset of commands that offer an interface to applications [Ref. 9, 10].

5.3 Standards Activities and Emerging Standards

(U) Standards activities in areas related to the SCF have been primarily in the area of developing international, nonproprietary standards for interfaces to operating systems. An international standard for an operating system appears unlikely to be developed, in part because operating systems are closely tied to the hardware architecture of vendor products. International standards for entities other than operating systems for providing the SCF functionality have not appeared and no work is known in this area.

(U) As indicated earlier, POSIX is becoming a widely accepted approach to standardizing interfaces to operating systems and an ISO draft international standard for POSIX based on work recently adopted by the IEEE is expected in 1989. Consortiums have been formed to develop and gain acceptance for profiles of standards that could be the basis for open environments and portable systems within these environments. All the consortiums have adopted POSIX; however, there are differences in the approaches being taken. Activities of these consortiums in the POSIX area are discussed in this section; additional information on portability profiles is provided in Chapter 8.

(U) The international nonprofit consortium, X/OPEN™, is developing extensions to UNIX SVID to a distributed (two-phase) transaction processing environment that meets OSI standards A layered functional model for this environment has been

2 (U) "Standard for Test Methods for Measuring Conformance to POSIX 1003.1," P1003.3, Draft 7.0, 2 August 1988, UNCLASSIFIED.

proposed that consists of resource, commit, and transaction management. This model requires certain extensions to the UNIX™ kernel (guaranteed output to files and concurrent input from peripherals). The X/OPEN System V Specification (XVS) is the initial recommended standard for the operating system. These enhancements would be part of a Common Applications Environment (CAE), a concept to promote software portability. This would be achieved by adopting and adapting existing industry and "de facto" standards, rather than by creating a new standard. Future goals for the CAE are alignment with POSIX P1003.1 (with a large number of extensions) and ANSI X3J11 "C", together with interfaces for Indexed Sequential Access Method (ISAM) and an embedded standard Relational Database Language (SQL). The X/OPEN version of ISAM is based on a major (implementation nonspecific) subset of C-ISAM Version 2.10 (January 1985) from the Informix Corporation. The initial X/OPEN version of SQL is not fully compliant with ANSI X3.135-1986 [Ref. 10-12].

(U) Another approach to developing standard interfaces to UNIX-type systems is being taken by the Open Software Foundation (OSF), an international consortium formed in May 1988. The emerging operating system interface standards would initially be based on AIX™, an IBM version of UNIX interfaces. The operating system is planned eventually to be fully compatible with the POSIX standards. In addition to the operating system, the other elements of the OSF architecture are: languages, user interface (e.g., distributed window manager), graphics libraries, networking services, and database management. Each element in the OSF Level Zero application environment specification is defined by existing ISO, FIPS, ANSI, and military standards. OSF is a non-profit, industry supported research and development organization whose activities are designed to promote an open, portable application environment.

(U) A third approach to developing POSIX-conformant operating systems is underway. This approach is based on providing a version of the Berkeley UNIX with a POSIX interface.

(U) A fourth approach has been announced by a new consortium called OPEN88. This consortium is reported to be planning to have a POSIX-conformant version of UNIX in late 1989 or early 1990.

(U) The U.S. National Institute of Science and Technology (NIST) has developed an Applications Portability Profile as an approach to identifying standards that could be used to achieve an open environment that would ensure a high degree of applications portability. In addition to the operating system, this environment includes data management, data interchange, network services, user interface, and programming services. POSIX is identified by NIST as the key, in addition to open systems interconnection, to such an environment. NIST has identified [Ref. 13] a number of areas in which the current POSIX definition must be extended in order to "provide full operating system functionality." These extensions include shell and tools, system administration, and terminal interface extensions. Extended POSIX would be part of an integrated set of non-proprietary standards. Efforts are still required to specify the appropriate standards and "bindings" for the open environment.

5.4 Options within the Standards

(U) To be provided.

5.5 Assessment of Coverage by Standards

(U) To be provided.

6. THE DATA MANAGEMENT FACILITY (DMF)

6.1 Description of the DMF

(U) The Data Management Facility (DMF) for ATCCIS is defined in WP 24 to be a logical entity in each ensemble that provides services for manipulating data objects to support the transfer of information between systems. The DMF provides the services related to transaction processing and database management, whereas the exchange mechanisms are provided by the Transfer Facility (TF). The purpose of data management is to represent the meaning and relationships of the information items required to perform key tasks, to ensure meanings and relationships are preserved when information is exchanged with another ATCCIS systems and to ensure changes to data items in ATCCIS systems are applied consistently wherever these items are stored.

(U) Peer interactions between two DMFs will be of two forms: either a DMF will be sending an update, or it will be requesting data. One or more standard query languages will form the basis of the peer-to-peer protocol for the exchange of data between ATCCIS systems. More than one data model (e.g., relational, hierarchical, image/map oriented) may be required for the DMF. The information transfer services are primarily constrained by finite communications bandwidth and security. Issues associated with security are currently outside the scope of this working paper; they are discussed in WP 12A.

(U) The DMF will provide mechanisms to accurately represent the meanings and relationships of the information items to be managed. These mechanisms include the data base system, the conceptual schema, and ATCCIS domains. For each ATCCIS data model to be supported, these mechanisms will provide a standard way of representing the data, including support for common data definitions. (The definitions as well as the data would be standardized during the implementation phase of ATCCIS.) An example of one type of support that could be provided is a data dictionary system, which could be used by ATCCIS conformant systems to maintain common data definitions and representations. Another example is the data definition language (DDL) that may be provided with a database system or language. The DDL must be rich enough in its forms of expression to have attributes required of both commercial and military systems. For example, it needs to have the capability to recognize several types of hierarchy for data classification and compartmentalization and be trusted to permit access by users with varying levels of authorization for these classification levels and compartments.

6.1.1 Partitioned, Partially Replicated Database System

(U) As described in WP 24c [Ref. 14], data transfer services in ATCCIS will be provided by a partitioned, partially replicated database system. Partitioning means that the entire ATCCIS database is segmented into disjoint parts that are held at geographically separate locations. Some of the parts of the ATCCIS database are copied or replicated at other locations to ensure survivability or to provide more rapid local access. A partitioned, partially replicated database provides sufficient flexibility for efficient exchange of information in a manner that minimizes usage of communications, by permitting either "push" access (for updates) or "pull" access (for queries).

6.1.2 Conceptual Schema

(U) A common conceptual schema will define all ATCCIS data related to information exchange.[3] The ATCCIS database will be segmented or partitioned into replication domains, each owned and managed by a specified sub-functional area. Each replication domain has one master copy and may have other copies referred to as slave

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3 (U) The schema may not identify information managed uniquely by a headquarters or by a national system.

copies. A single DMF would be able to access some, but not all the master and replication domains.

6.1.3 Domains

(U) Each domain comprises two parts. One part (designated domain details) provides the characteristics and control information for the domain. Examples of possible domain details are: name, owning sub-functional area, home ATCCIS ensemble for the master domain, list of permitted users, component addresses for the replication domains, and security classification parameters. The other part of a domain (designated domain data) provides the values of each data item. The representations of some features of a domain, such as data item characteristics, data relationships, and data dictionaries are implementation dependent and have therefore not been specified.

6.1.3 Required Services

(U) The DMF provides these basic services [Ref. 14]:

- Data definition--provides a common understanding between systems on the attributes and meaning of data
- Local queries--queries that can be satisfied by a data item or a set of items as specified in parameters supplied in the query, subject to authentication of the requestor's identity before issuing the data, such that the data resides in either a master or slave copy at the location where the query is made
- Remote queries--transfers, from a remote master or slave copy, a data item or a set of items as specified in parameters supplied in the query, subject to authentication of the requestor's identity before issuing the data, from a location other than the one where the query originated
- Consistency control--ensures that any updates to values of data items in a slave copy ultimately become the same as the values in the master copies of the relevant domain; consistency control also ensures that update transactions are applied in the correct order
- Local updating--provides for changing the values of a data item or set of data items for a domain, where the master copy is held at the same location as the one where the update originated
- Local slave updating--provides for changing the values of a data item or set of data items for a slave domain, but without replication of the updates

- Remote updating--provides for changing the values of a data item or set of data items for a domain, where the master copy is at a remote location; these operations are subsequently directed to all slave copies of the relevant domain
- Integrity of replicas--ensures that each replica, together with deferred updates, can be used to replace the master domain in the event of a system failure
- Management of distribution--supports the partitioning and partial replication of the databases
- Recovery from failure--provides mechanisms to decide that there has been a failure, allow recovery from failure, and permit a slave copy to become a master copy
- Support of change of location of command (COLOC) and succession of command (SUCOC), by permitting a slave to become the master and by permitting new slave copies to be designated dynamically
- Database statistics--provides status and usage data for the system manager
- Database initialisation--provides for the creation and loading of initial values of a database and its replicas when the system is initialised

(U) In addition, the DMF will provide the following management services [Ref. 14]:

- Create domain--creates a new, empty domain, either as a master copy or for use as a replication copy of a domain
- Delete domain--deletes a domain and erases all data in that domain (when applied to a master copy, it will delete all associated replication copies)
- Transfer domain--causes, when proceeding to normal completion, the master of the domain to become a slave copy and the slave copy at a designated replication component to become the master
- Assume domain--provides for change of ownership of a domain
- Unassume domain--provides the capability to resolve the situation in which more than one ATCCIS component has exercised assumption of the same domain, by designating another domain as the master
- Amend domain--provides for changing the characteristics of a domain, such as the list of users or the replication list, by the owner or other authorised user
- Details domain--provides for query of the details or characteristics of a domain by an authorised user
- Copy domain--copies the entire contents of a domain, both characteristics and data, to a replication copy (space for the copy is first created by create domain)

- Restore domain--allows the owner of a domain to recreate the data in the master copy of the domain by copying it from a replication copy, in support of data recovery after failure
- Advise domain--allows an ATCCIS component to be interrogated to see if it holds a copy of a domain (this permits components who have lost and then reestablished communications to find out whether the replication list is correct).

(U) Some options for standardizing the appropriate features of domains are inherent in the discussions in the sections that follow. Some services being evaluated to provide database operations (not yet adopted) imply implementation of a relational database architecture; examples of database operations are: select, update, delete, insert, project, product, union, intersect, difference, divide, join, and equijoin.

6.2 Standards to Support the DMF

6.2.1 Data Definition and Manipulation Language Standards

(U) There are now two data manipulation language standards approved by ISO, ANSI, and FIPS: NDL[4] and SQL.[5]

6.2.1.1 Database Language NDL

(U) *Database Language* NDL (IS 8907, ANSI X3.133-1986, FIPS 126) is an outgrowth of 1978 CODASYL specifications using a network model for a data definition language (DDL) and a data manipulation language (DML). NDL is characterized, in part, by extensive use of logical pointers These pointers support such facilities as FIND NEXT (push down in a stack) and FIND OWNER (pop up in a stack). The specification work was conducted 1981-1986 by the ANSI X3H2 Database Committee. No follow-on standards activities are being conducted by ISO or ANSI for NDL [Ref. 15,16].

6.2.1.2 Database Language SQL

(U) SQL (IS 9075, ANSI X3.135-1986, FIPS 127) is based on a relational database model, and the specification work was conducted 1982-1986

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4 (U) NDL is not an acronym; historically, the term derived from the concept of a network data language.

5 (U) SQL is also not an acronym; historically, the term derived from the concept of a structured query language, but today SQL represents much more than a structured query language.

by the ANSI X3H2 Database Committee. Future work in the standards for database management systems by ISO and ANSI/X3H2 is on distributed database processing (e.g., remote data access protocol) and extensions to SQL.

(U) Both ISO and ANSI are working closely together and in parallel on a follow-on standard, SQL2. A draft proposal version of the SQL2 standard is planned for release about August 1988; adoption is planned for the Spring of 1990. SQL2 is expected to incorporate the following draft addenda:

- Addendum 1 (IS 9075/1), entitled, "Integrity Enhancement Feature," provides for check clauses, default clauses, and referential integrity constraints
- Addendum 2 (SC21 N2663) would provide for the formal incorporation as a standard of the appendix in IS 9075 on embedded SQL for COBOL, FORTRAN, PL/1, and Pascal. Further, it would extend standards for embedded SQL to two more programming languages, Ada and "C."

(U) Work has already begun on SQL3, which is planned to become a standard about 1993. SQL3 would contain the following features:

- Generalized triggers (similar to IF...THEN statements; based on a condition of data, not time)
- Generalized assertions (given a certain condition to trigger integrity checks on the database; e.g., to do before and after validation on values in the database)
- Recursive expressions (these allow an open-ended subordinate assertion, e.g., for completely searching a tree--currently, only finite queries to specified levels are permitted)
- Escape from SQL to call external features
- Basic capability for user-defined data types (the only structure in SQL is a table; this allows user to declare a domain separate from a table)
- Support for subtables, provided through inheritance and generalization features
- Appropriate support tools for object-oriented and knowledge-based systems.

6.2.3 Standards for Interfacing Data Definition and Manipulation Languages to OSI Service Elements

6.2.3.1 Remote Data Access (RDA)[6]

(U) RDA is an ISO standard to facilitate access to databases from intelligent workstations and from other database systems. It is essentially a (standard) generalization of certain operations of database systems, file servers, and document servers. RDA service is designed to provide all possible valid data manipulation functions on any database. The functions needed (and available) depend on the structure and content of the database, so the definition of these functions must be accomplished at run time (not explicitly coded into software). Thus RDA allows data management language operations to be defined and named (actually numbered) so that they can be repeatedly invoked later in an application and association.

(U) The ISO standard for RDA, DP 9579, defines the format and meaning of messages that support this application. RDA uses common OSI services for association control service elements (ASCEs, DIS 8649 and DIS 8650), commitment concurrency and recovery (CCR) service elements (DIS 9804 and DIS 9805), and remote operations service (ROS) elements and protocols (DP 9072) to effect the communications needed. RDA can be viewed as a composition of ACSE and CR with a specialization of the ROS. RDA needs no specific protocol of its own; it only requires additional sequencing rules and a method for handling violations of them. The Abstract Syntax Notation standard (ISO 8824 and ISO 8825) is used in the presentation layer to define structures (data types) and rules for encoding structures so that the structures can be transmitted.

(U) The ISO standard DP 9579 (December 1987) is based on work of ECMA Technical Committee on Databases, CCITT, and ISO SC18. ECMA TR 30 (December 1985) was starting point for RDA and ECMA TR31 initially defined the concepts, notation, and connection-oriented mappings for remote operations.

(U) The remote operations philosophy is based upon object modelling, in which the functionality of an object is modelled as a set of operations available at its interface. Object modelling also includes the notion of object classes, subclasses, and property inheritance. In RDA these concepts are used to define a generic

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6 (U) Discussion taken from"Remote Database Access, Tutorial," SC21 N1927, ISO/TC97/SC21, 28 July 1987, UNCLASSIFIED.

RDA, which defines a class of remote data base access applications, and specific RDAs, each of which defines a subclass of RDA applications. Those properties common to all RDA applications are defined in the generic RDA. Those that relate to subclasses are defined in RDA specializations.

(U) The generic RDA can support any data management language. One of the specific RDAs is a specification for the Database Language SQL.[7] Other specific RDAs to be developed in the near future are also expected to be based on the relational approach. The relationship data management language was chosen because it supports complex selection functions and multirecord operations for updating and deletion. This enables the RDA to accomplish selection processing in the database server (the place where the data is stored). This reduces the amount of unneeded data that is transferred to the client (user), and thus minimizes use of communications.

6.2.3.2 Remote Operations Service Elements (ROSEs)

(U) ROSE standards are discussed with the TF. These service elements may also be used to support the DMF. See Section 4.2.4.

6.2.4 Data Dictionary Standards

(U) The Information Resource Dictionary System (IRDS) is a data dictionary standard being developed in parallel by both ANSI (X3H4) and ISO. The standard is based on the entity-relationship model and would be applicable to both the standard database languages, NDL and SQL. The ANSI draft standard is identified as X3.138-1988, and the ISO is DP 8800-1 (March 1987) and DP 10027 (April 1988). Unfortunately, the ANSI and ISO communities have recently diverged over the issue of whether relationships are permitted to have attributes (ANSI) or not (ISO). The rationale for the simpler model (no attributes) is that it would fit more easily with SQL tables. The rationale for the ANSI position is that a model permitting attributes, while more complex and more difficult to use, would provide greater flexibility. Further, a lot of existing products would be invalidated if no attributes were permitted for the relationships.

(U) IRDS provides for two types of user interfaces: a menu-driven "Panel" Interface and a Command Language Interface. The Panel Interface provides for a

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7 (U) "Remote Database Access: SQL Specialization," SC21 N2643, ISO/IEC JTC 1/SC21/WG3, 9 May 1988, UNCLASSIFIED.

structured path of screens (i.e., panels) by which an inexperienced user can execute IRDS functions. The Command Language may be used in either an interactive or batch mode. One of the facilities provided in IRDS supports the moving of data from one standard dictionary to another.

(U) IRDS, including the Command Language and Panel Interfaces, is specified in terms of entities, relationships, and attributes. The entities represent or describe the concepts and data objects about which values are to be stored in the database. Relationships are binary associations between two entities (e.g., one contains the other). Attributes represent the properties of an entity or relationship. Each relationship and attribute is assigned a specific type. Entities can be compared if they have a common attribute with a common type. Ordered sets of attributes, called attribute groups, are also provided in IRDS. The IRDS schema that defines and controls what is permitted in a data dictionary is also defined using entities, relationships, attributes, and attribute groups. IRDS support local and universal naming conventions through three types of entity names: Access names (used with the command language), descriptive names (e.g., from an ATCCIS-wide data dictionary), and alternate names (e.g., aliases used for the convenience of one or more nations or one or more ATCCIS components). IRDS functions include: adding, deleting, modifying, and copying entities and relationships; and report writing.

6.2.5 Distributed Transaction Processing Standards

(U) A reference model for distributed Transaction Processing (TP) has been developed by ISO/TC97/SC21/WG5. The working document (ISO TC97/SC21 N 2092) has now reached the draft proposal stage in ISO (DP 10026). Transaction Processing service elements are viewed as pertaining to the ISO application layer (layer 7). While TP services are discussed in relation to the DMF, some of these services may be provided by the SCF and TF.

6.3 Standards Activities and Emerging Standards

6.3.1 ISO Standards[8]

(U) Working Group 3 (WG3, Database Management Systems) of ISO Study Committee 21[9] (SC21; Standardization Committee on Information Retrieval, Transfer, and Management for Open Systems Interconnection), through the Vice Chairman, Systems (VCS), Technical Committee of Information Processing Systems (TC97), is developing standards for distributed databases. These include conceptual schema [Ref. 17], a data management reference model (DMRM), an information resource dictionary system, remote data access, transaction processing, and the database languages NDL and SQL. Some recent publications include:

- Remote Database Access (DP 9579, December 1987)
- Remote Operations (DIS 9072-1.2, Model, Notation, and Service Definition; DIS 9072-2.2, Protocol Specification; June 1988)
- Concepts and Terminology for the Conceptual Schema and the Information Base (TR 9007, July 1987)
- A draft standard (TC97/SC21 N2132, September 1987) for IRDS services
- IRDS framework (April 1988)
- Data Management Reference Model (DP 10032, May 1988)
- Distributed Transaction Processing specifications (DP 10026-1, Model; DP 10026-2, Service Definition; DP 10026-3, Protocol Specification; March 1988)
- Database Language SQL (ISO 9075 DAD1, December 1987).

6.3.2 CODASYL Standards

(U) CODASYL data management standards are the responsibility of the CODASYL Systems Committee. A report on distribution alternatives and generic architectures for distributed database systems was produced by this committee in 1980 [Ref. 18]. One of the two standard ISO data management languages (NDL) is based on CODASYL concepts.

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8 (U) There are three stages for development of ISO standards: draft proposal (DP), draft international standard (DIS), and international standard (IS).

9 (U) Study Committee 21 is responsible for the OSI Reference Model, the OSI Management Framework, and its continuing development. See Figure 3.1.

6.3.3 ANSI Standards

(U) ANSI standards for database architectures are produced by the Database Architecture Framework Task Group (DAFTG) through the Standards and Planning Requirements Committee (SPARC). A draft report [Ref. 19] from the DAFTG in 1982 provided a framework to support distributed databases, multiple data models, and data dictionaries. One concept, the abstract syntax notation (ASN), has been specified [Ref. 20, 21].

6.3.4 ECMA Standards[10]

(U) The European Computer Manufacturers' Association (ECMA) has issued a final draft report [Ref. 22] for remote database access service and protocol.

6.3.5 Other Standards

(U) CCITT does not provide standards for data management. The U.S. Government Open Systems Interconnection Profile (GOSIP) does not appear to provide standards for data management [Ref. 23].

6.4 Options within the Standards

6.4.1 Options Within SQL

(U) The ANSI standard X3.135-1986 SQL allows for two levels of compliance. Level 1 is a core standard that leaves many areas open to implementation definition. Level 2 contains many extensions over Level 1, but Level 2 still has a large number of options for implementation. Examples of facilities found in Level 2 but not in Level 1 are [Ref. 10]:

- Atomic transactions with respect to recovery
- 18-character identifiers
- Table-name qualification by user-name
- Indicator variables
- Outer references
- Keyword ALL allowed in query-specifications, sub-queries, and set functions

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10 (U) ECMA full membership is open only to companies who develop, manufacture, and sell computers in Europe. The restricted membership makes full consensus among participants in standards-making easier and quicker to reach than in ISO.

- Updatable query-specification definitions
- Statements atomic with respect to database changes
- <> in comparisons
- Escape characters in the LIKE predicate
- REAL, DOUBLE PRECISION, AND NUMERIC data types
- WITH CHECK OPTION on a view definition
- WITH GRANT OPTION on a privilege definition
- DISTINCT with AVG, MAX, MIN, and SUM.

6.4.2 Options Within NDL

(U) To be provided.

6.5 Assessment of Coverage by Standards

(U) To be provided.

7. THE SYSTEM MANAGEMENT FACILITY (SMF)

7.1 Description of the SMF

(U) The system management functions are identified in WP 24 as managing and updating a set of parameters that relate ensemble operations to other parts of the host system or other ATCCIS systems. The parameters (not yet specified) would be those required to ensure maximum continuity of service to the users in the event of equipment failure. The majority of system management services will be provided by the transfer of system management data using standard DMF services.

(U) The SMF is a logical entity that will interact on a peer basis as appropriate to provide specified services which cannot be provided by alternate means. Examples of system management data may be the logical-to-physical tables used by the TF and the tables defining the DMF domains.

(U) WP 24d (Edition 1.0, September 1988) identifies as system management functions all activities of the system controller, system administrator, database administrator, and network administrator with the aim to control the system operations. The system management activities identified were: allocate resources, expand resources, distribute/disperse resources, move/relocate, crypto management, access right management, mode of operation selection, initialization, monitor system status, control system operations, and termination.

(U) The following SMF services, only available to privileged users, are required:

- Query at remote locations
- Cancel at remote locations.

These are sometimes referred to as remote query/cancel handling (RQCH).

(U) SMF works at the application level. Functionality unique to the SMF is very limited. Specifically, SMF is required to manage the concepts for Service Requests that have been identified [WP 24] for ATCCIS. This may mean that SMF-unique functions may be ATCCIS-unique, and there may not be standards that address it. Further, most of the system management functions are expected to be provided as national-unique system management applications that use the other basic ATCCIS facilities.

7.2 Standards to Support the SMF

(U) No standards unique to the SMF have been identified. Further, none may be required.

7.3 Standards Activities and Emerging Standards

(U) Not applicable.

7.4 Options within the Standards

(U) Not applicable.

7.5 Assessment of Coverage by Standards

(U) Not applicable.

8. COMPARISON OF RESULTS WITH PLANS FOR NEAR-TERM SYSTEMS

8.1 Introduction

(U) This chapter will examine near-term military efforts to implement open system architectures. The purpose is to check the standards and stacks identified in earlier chapters to see if they adequately identify options and related standards. In addition, this chapter will address some of the issues associated with evolving from near-term systems to ATCCIS through the use of standards. Some profiles of standards used in transition implementations are also presented.[11]

8.2 Comparison of WP 25 Analysis with Other Near-Term Efforts

(U) This section examines the standards specified by three near-term interoperability demonstration efforts, namely the Quadrilateral Interoperability Program QIP), the Standard Automated Message Interface for NATO's ACCISs (STAMINA), and the Air Command and Control System (ACCS). Military features required by NATO are also addressed in this section. The objective of this review is to ensure that the methodology used for the ATCCIS effort is comprehensive and that no classes of relevant standards have been overlooked.

8.2.1 Review of Quadrilateral Interoperability Program

(U) The Quadrilateral Interoperability Program is an initiative of four nations (France, Germany, United Kingdom, and United States) to develop and implement, for the short term, an interoperability gateway between the four national Automated Command and Control Information Systems (ACCISs), respectively SACRA, HEROS, WAVELL, and MCS.

(U) The Quadrilateral Tactical Interface Requirements (QTIR) document expresses the basic requirements. The Quadrilateral Technical Interface Design Plan (QTIDP) [Ref. 25] specifies, for the gateway, the technical interface based on the ISO/CCITT seven-layer reference model. The operational requirements specify for information representation the use of formatted messages as described in STANAG 5621

[11] (U) Profiles differ from stacks in that a profile usually consists of several stacks of standards and further that profiles are usually recommended for a certain transition strategy or a specific implementation. In some cases, profiles specify options to be used.

Edition 2 and in accordance with ADatP-3 specifications (STANAG 5500). The specifications for the common international interface between national gateways are provided in the QTIDP by annexes describing each of the seven layers with options and parameters derived from ISO/CCITT standards to meet the specific military requirements (e.g., naming, addressing, priority, sensitivity, size of messages, and segmenting).

(U) Standards specified in the QTIDP are identified in Table 7. Specifications of Layers 1 through 5 are closely related to ISO standards. Layer 6 (presentation) is a null layer. Layer 7 specifies message handling functionality based upon the CCITT X.400 standards for the subset of service elements provided by P1 and P2 protocols and the service elements provided by Reliable Transfer Service (RTS), as defined by ISO 9066-2, and integrated with the Association Control Service Elements (ASCEs, ISO 8649 and ISO 8650) that provide support for other application entities. The Quadrilateral Test and Demonstration Management Plan (QTDMP) specifies a Quadrilateral plan for interface testing and interoperability testing before performing a demonstration early in 1990. Most of the interoperability parameters are specified by the options, classes,and system parameters selected from ISO/CCITT standards; some of the other interoperability parameters are defined in accordance with military requirements defined for messages in the QTIR.

(U) A preliminary review has shown that all standards, stacks, and options for the Quadrilateral Interoperability Program that are also relevant to ATCCIS have been identified in earlier chapters of this working paper. In addition, a separate analysis [Ref. 26] has been performed that identifies a large number of interoperability parameters and provides their values.

8.2.2 Standard Automated Message Interface for NATO's ACCISs (STAMINA)

(U) This summarizes the results of a review of the specifications for STAMINA [Ref. 27]. STAMINA is being developed by an Interface Working Group of NATO Communications and Informations Systems Agency (NACISA) to be used as a standard interface for passing information among ACCISs. Initial demonstrations are planned for the Central Region ACCIS and three target systems: the Allied Command Baltic Approaches Command and Control Information System (ACBA CCIS), the Central Region Alternate War Headquarters CCIS (CR AWHQ CCIS), and the Allied Tactical Operations Center CCIS (ATOC CCIS, also known as the EIFEL Follow-On). The messages are free text and text formatted according to the ADatP-3 specification [Ref. 28]. Requirements for the Quadrilateral Interoperability Program and STAMINA overlap, but it is not clear at this time if they will converge.

Table 7. (U) Standards for Quadrilateral Interoperability

UNCLASSIFIED

Layer	References for Standards
7. Application	ISO 8649-1986 ISO 8650-1986 CCITT X.400, X.401, X.408, X.409, X.411, X.420 DIS 9066-2
6. Presentation	DIS 8822-1985 DIS 8823-1985
5. Session	DIS 8326-1984 DIS 8327-1984
4. Transport	DIS 8072-1984 DIS 8073-1984
3. Network	ISO 8208-1985 DIS 8348-1985 DP 8878-1984 CCITT X.25-1984
2. Data Link	ISO 7776-1985 DIS 8886-1985
1. Physical	ISO TR 7477-1985 DIS 8481-1985 ISO/TC97/SC6 N3631 (DP 10022) CCITT X.21

(U) Table 8 identifies the standards specified for the STAMINA transport profiles. Some differences between STAMINA and the Quadrilateral TIDP are noted in Appendix D of Ref. 27. In some of the cases of differences STAMINA follows CCITT and ISO standards, whereas the Quadrilateral has deviations from the cited standards (e.g., message handling).

(U) STAMINA includes the selection of CCITT and ISO standards, along with allowable options and parameters, necessary to attain interoperability among the end systems. Some unique military message handling requirements, such as priority and sensitivity, are also adhered to as specified by the NATO Interoperability Model [Ref. 29] and the associated STANAGs (e.g., STANAG 4250). STAMINA is based on the following application and telecommunication profiles (A-profiles and T-profiles) as defined in the Standards Promotion and Applications Group (SPAG) User's Guide [Ref. 30]:

- Permanent Telephonic Circuit Providing Connection-Oriented Network Service (T/21)
- Telephonic Switched Circuits Providing Connection-Oriented Network Service (T/22)
- Permanent Access to Packet Switched Data Network (PSDN) (T/31)
- Private Message Handling Service (MHS) Access (A/3211).

Table 8. (U) Standards for STAMINA Transport Profiles

UNCLASSIFIED

	Transport Profiles		
Layer	**T/21**	**T/22**	**T/31**
4. Transport	ISO 8072 ISO 8073 (1)	ISO 8072 ISO 8073 (1)	ISO 8072 ISO 8073 (1)
3. Network	ISO 8348 ISO 8208 ISO 8878 STANAG 4214 STANAG 5046	ISO 8348 ISO 8208 ISO 8878 STANAG 4214 STANAG 5046 CCITT V.25bis	ISO 8348 ISO 8208 ISO 8878 STANAG 4214 STANAG 5046
2. Data Link	ISO 7776 (2)	ISO 7776 (2) CCITT V.25bis	ISO 7776 (2)
1. Physical	CCITT V.24 CCITT V.11 ISO 2110 ISO 4902 ISO 4903 MIL-STD-188C	CCITT V.24 CCITT V.11 ISO 2110 CCITT V.25bis MIL-STD-188C	CCITT X.21 CCITT V.11 ISO 2110 ISO 4902 ISO 4903 MIL-STD-188C CCITT X.21bis

(1) Classes 0 and 2 are mandatory; class 4 is optional.

(2) Options 2 and 8 are mandatory; option 10 may be included under bilateral agreement.

(U) The STAMINA specification is only concerned with profiles based on the ISO Reference Model. That specification considers it to be a local implementation issue to realize the required functionality whenever an end system is unable to conform to the desired profile. STAMINA identifies deviations from CCITT and ISO standards for each layer and for each specified profile.

(U) The A/3211 application profile is the X.400 MHS, in which the application layer (Layer 7) has three sublayers: User Agent Layer defined by X.420, Message Transfer Layer defined by X.411, and Reliable Transfer Server defined by X.410. The A/3211 presentation layer (Layer 6) is defined by ISO 8823 (based on X.410), and the session layer (Layer 5) is defined by ISO 8327 (based on X.410).

(U) Several options identified in Table 8 are not yet discussed in early sections of this working paper. These areas need to be treated in more detail. In addition, there are several implementation phases and end system descriptions for STAMINA that should be examined further [Chapter 4 and Appendix A of Ref. 27].

8.2.3 Review of Air Command and Control System (ACCS)

(U) NATO is in the process of developing an Air Command and Control System (ACCS) program. Development of ACCS, which integrates offensive and defensive air command and control functions, has been underway for several years. Implementation is planned for the early 1990s. ACCS will integrate and harmonize new systems not yet designed with systems currently being implemented, such as Improved United Kingdom Air Defence Ground Environment (IUKADGE), Systeme de Traitement et de Representation des Informations de Defense Aerienne (STRIDA), German Air Defence Ground Environment (GEADGE), and NATO Airborne Early Warning (NAEW). At the PSC level and above, ACCS will be interfaced to and carried by the ACCIS of each Command.

(U) Interoperability for ACCS is discussed in the ACCS Master Plan [Ref. 31]. While the ISO Reference Model and associated NATO standardization agreements (STANAGs) have been adopted for ACCS, no information was found in the Master Plan about specifying specific stacks or options for these standards.

(U) ACCS interoperability is planned through exchange of information through commonly agreed to information definitions, formats, and technical standards. Where possible, the standards to be used are those developed by MAS, Allied Data Systems Interoperability Agency (ADSIA), and TSGCEE(SG9). Specifically, ACCS will be based on the OSI Reference Model as specified in STANAG 4250 (NATO

Interoperability Model), the OSI services for layers 1 through 7 as specified in STANAGs 4251-4257, and the OSI protocols for Layers 1 through 7 as specified in STANAGs 4161-4267. In addition to the ISO Reference Model standards, the NATO Common Interface Standards will be used. TSGCEE(SG9) is responsible for the ISO-OSI technical standards, and ADSIA is responsible for the procedural standards. Operational interoperability standards will be based, in part, on Allied Tactical Publications (ATPs). In addition, the CCITT ISDN network architecture is being evaluated for full integration of communication services in ACCS.

(U) ACCS will use both character- and bit-oriented message formats. ACCS character-oriented information exchange is based on the ACE Reporting System (80-50), together with supplements developed by the Commands. ADSIA is developing standardisation documents for character-oriented messages, including a "Common Information Exchange Glossary" and a catalog (ADatP-3/STANAG 5500) of character-oriented formatted messages. Various tactical data links (TADILs) were evaluated for bit-oriented message exchange, and the J-Series message catalog was selected for use in ACCS. Gateways may be required to perform standard translation and other functions if more than one message standard is adopted for systems currently in development. The long-term goal for ACCS is a common bit-oriented message standard for the ground environment.

8.2.4 Military Enhancements to OSI

(U) In 1986 a number of military requirements were identified that are not adequately covered by existing ISO standards. The Ad-Hoc Management Group (AHMG) on OSI Management, TSGCEE(SG9), has recommended [Ref. 29, 32] that the OSI Reference Model be extended to provide to the following Military Features:

- Multihomed and mobile host systems
- Multiend point connections (multiaddressing)
- Internetworking
- Network or system management functions
- Security
- Robustness (resilience) and quality of service
- Precedence and preemption
- Real-time and tactical communications.

The AHMG has been tasked to [Ref. 33]:

- Define the requirements for management in a military OSI environment
- Investigate the influence of the Military Features on the OSI management standards under development by ISO
- Influence ISO, and other standards bodies as appropriate, to adopt any additional military features identified
- Develop any additional military management standards for the requirements not met by ISO
- Assist in the coordination of management work within NATO
- Provide support for OSI management to SG9 and its working groups.

Initially, the AHMG identified six functional areas in OSI that could be impacted by the proposed Military Features: fault management, configuration management, security management, accounting management, and performance management. Major enhancements in these functional areas were anticipated if all the Military Features were to be fully supported. Chapter 7 of Ref. 33 documents the anticipated impacts of each feature on each functional area. Ref. 33 also provides a discussion of network management and security for OSI systems (Annex C) and detailed analyses of the six functional areas (Appendices 1 to 6).

(U) During the last three years TSGCEE SG9 WG2 has been working to have features required by the military be incorporated by standards bodies into the Message Handling System. The proposals, sometimes referred to as military message handling system (MMHS), included adding confidentiality, integrity, authentication, message store with access protocols, and directory services. Most of the proposals have now been incorporated in CCITT X.400-1988. To be known as the "blue book," X.400-1988 is expected to be ratified in November 1988.

(U) One area of MMHS not addressed by X.400-1988 is support for trusted functionality. Such support may be covered by standards developed the the US National Security Agency. These standards are called Secure Data Network System (SDNS); they provide for subprotocols between layers to carry out services associated with trusted functionality.

(U) Table 9 identifies the STANAGs that are planned for the next few years that will specify ISO standards and applicable military options and extensions, if any.

Work has begun on many of these STANAGs, but drafts for most have not yet been released.

Table 9. (U) NATO OSI Standards

UNCLASSIFIED

Layer	Service STANAG	Definitions Draft	Protocol STANAG	Definitions Draft
General	4250	Apr 86		
1	4251	Jul 88	4261	Jul 88
2	4252	6 Jul 88	4262	6 Jul 88
3	4253	Jul 88	4263	Jul 88
4	4254	Jul 88	4264	Jul 88
5	4255	Under Dev	4265	Under Dev
6	4256	Under Dev	4266	Under Dev
7	4257	Under Dev	4267	Under Dev

8.3 Migration From Near-Term Systems to ATCCIS

(U) This section will identify activities and options to support transition from existing military and other standards to ISO and other standards for open environments. Examples are application gateways, directory services, test systems, and test methodology. Initiatives at the NBS [Ref. 34] and elsewhere will be examined. Efforts from organizations that highlight functional standards, select stacks of mature standards and options within standards, and harmonize implementations will also be examined. One example is the Guide to the Use of Standards [Ref. 30] developed by the Standards Promotion and Applications Group (SPAG) in Europe. Functional standards based on OSI standards will also be developed by the Interoperability Technology Association for Information Processing, Japan (INTAP), specifically towards an interoperable distributed database system [Ref. 35]. Recommendations for functional standards and cooperation with European and U.S. organizations and companies are also provided in Japan by the Promoting Conference for OSI (POSI), founded in November 1985.

(U) The following sections provide examples of the transition strategies being considered in one or more of the Nations to migrate toward open information system environments.

8.3.1 GOSIP

(U) This section discusses UK GOSIP and US GOSIP. Documentation for UK GOSIP (*Procurement Handbook for GOSIP*, and *Specifications*) has recently been issued (March 1988). Figure 8 summarizes the standards recommended for UK GOSIP. Figure 9 summarizes the standards and options recommended for US GOSIP [Ref. 23]. Note that only connectionless transmission modes are recommended for US GOSIP.

(U) In the next (1989) version of US GOSIP, the following protocols are scheduled to be included: Virtual terminal (TELNET and Transparent Profiles), ES-IS discovery protocol, connection-oriented network service, and ODA/ODIF. Additionally, these protocols would be added in 1990: directory services, interim network management, ISDN, Virtual Terminal (page, scroll, and forms), connectionless transport, 1988 CCITT extensions to MHS, FTAM extensions, and FDDI.

8.3.2 X/OPEN Common Applications Environment

(U) This section discusses the Common Applications Environment (CAE) developed by the X/OPEN international consortium and specified in the X/OPEN Portability Guide [Ref. 10, 36]. The Portability Guide recommends standards and options within standards to achieve an open environment in which new applications can be ported without modification. Several international consortiums have endorsed the X/OPEN CAE as a basis for developing open environments.

(U) The foundations of the X/OPEN CAE are the interfaces of the UNIX System V operating system, as defined in the AT&T System V Interface Definition (SVID), and the "C" language. The X/OPEN CAE consists of features grouped in five functional areas: operating system, languages, data management, hardware, and networking.

(U) The primary feature of the operating system is the X/OPEN System V Specification (XVS) that defines the applications interfaces to be provided by the underlying operating system. Another feature of the operating system functional area is the

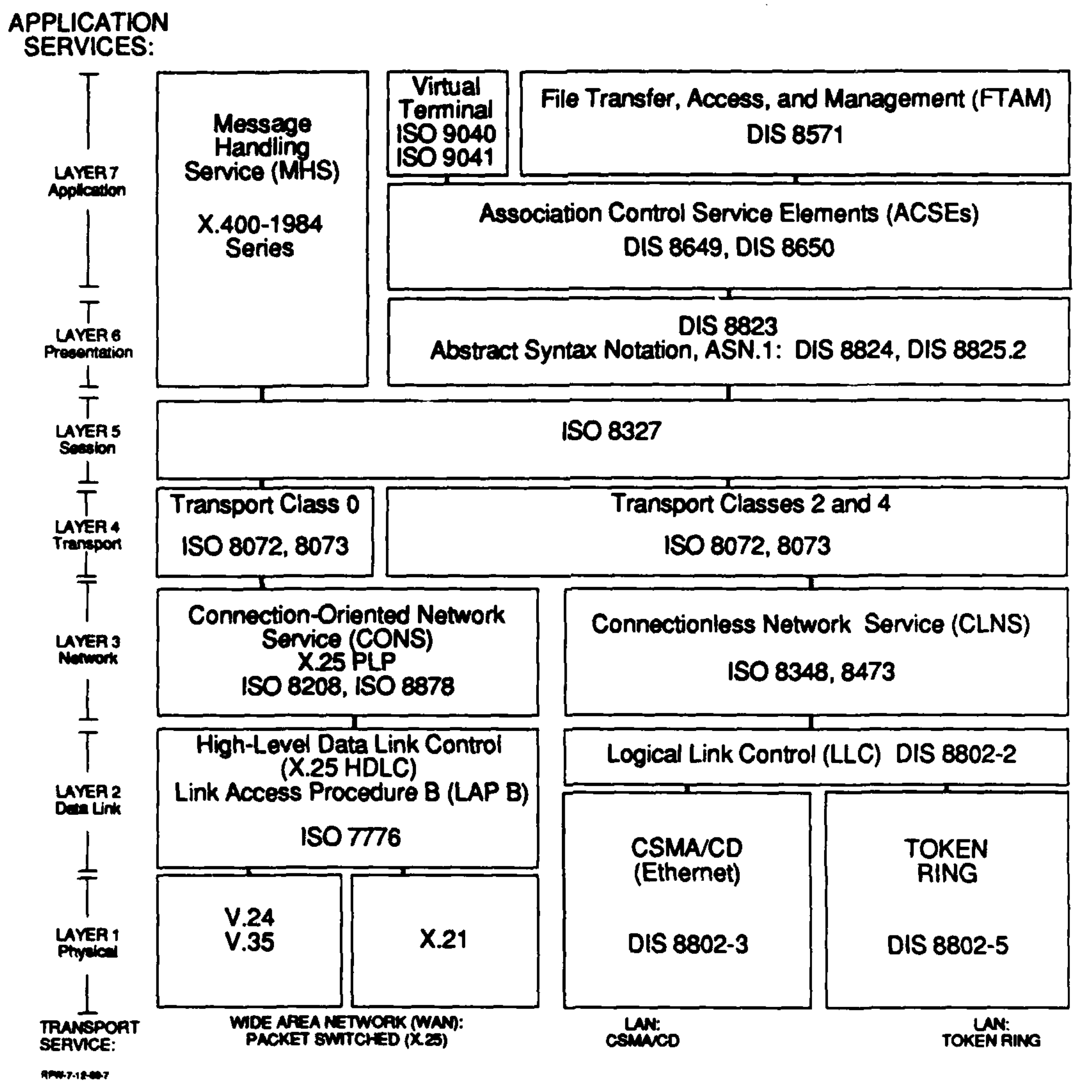

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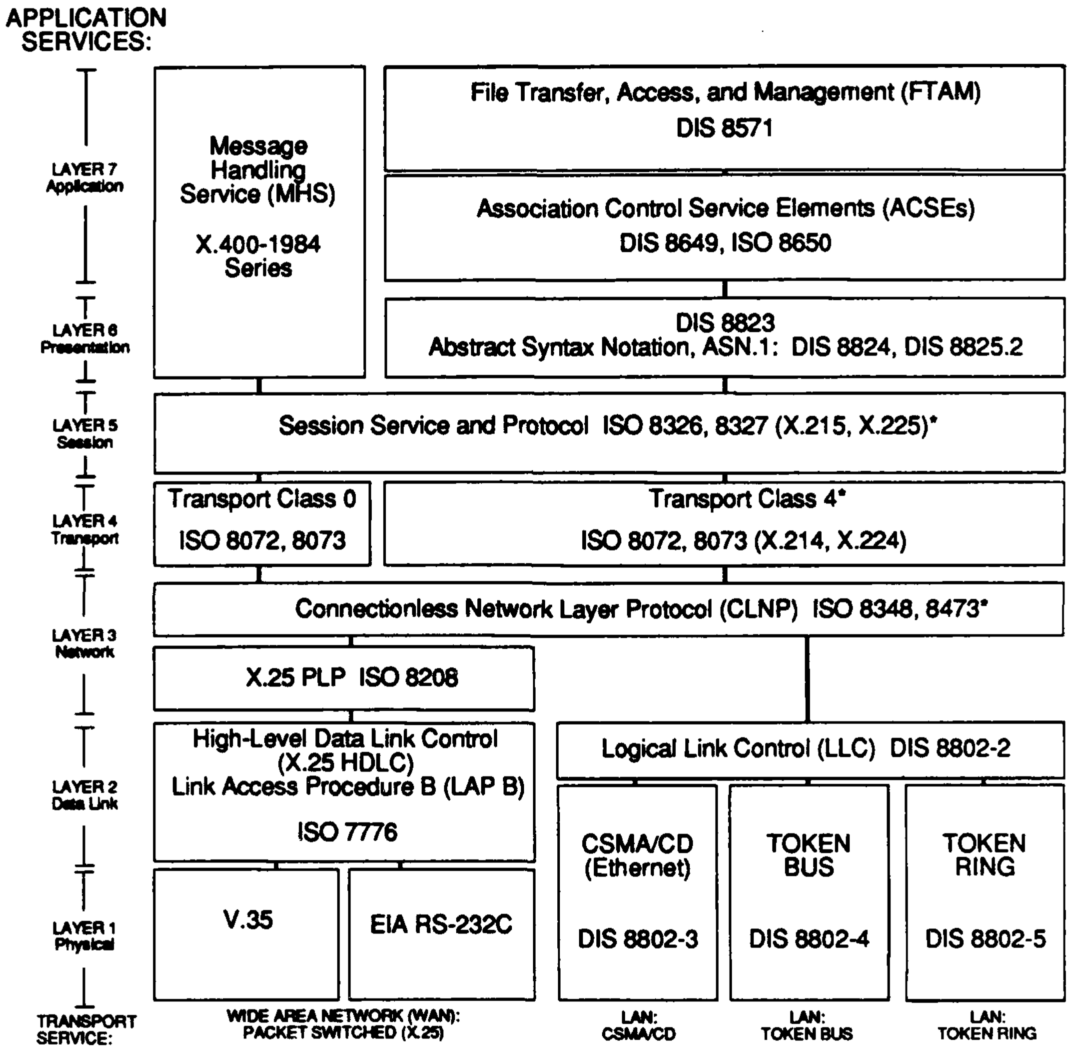
Figure 8. (U) Stacks of Standards Recommended for UK GOSIP



*Required for all conformant systems.

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Figure 9. (U) Stacks of Standards Recommended for US GOSIP

X/OPEN Native Language System, which is a set of interfaces designed to facilitate the development of applications that can operate in different languages and cultural environments. These two features are defined in the following ways:

- XVS mandates the entire SVID base definition with the exception of the mathematics group.
- XVS has extended the SVID, including extended use of symbolic names to replace numeric constants.
- Some of the SVID kernel extensions are optional in XVS (use of these options could restrict portability).
- The Native Language System is supported by a message catalogue system (messages in the appropriate language are retrieved at run time); a mechanism whereby native language, local custom, and code-set requirements can be identified to applications at run time; enhanced interface definitions of standard "C" library functions to provide language dependent character type classification and special conversions; and a set of standard commands and library functions that will operate correctly with 8-bit characters.

(U) The "C" language is the primary feature of the language functional area. The X/OPEN Portability Guide provides guidelines for writing programs designed to be portable and to avoid problems that arise between the AT&T System V "C" standard (used for the initial X/OPEN standards) and the draft standard issued by ANSI X3J11. X/OPEN has also established definitions for COBOL (based on ANSI X3.23-1974), FORTRAN (based on FORTRAN 77, ANSI X3.9-1978), and Pascal (based on ISO 7185-1983 Level 1).

(U) Data management includes Indexed Sequential Access Method (ISAM) interfaces that are defined for creating, managing, and manipulating indexed files; and SQL for access to relational database management systems. The ISAM definition is based on Version 2.10 of C-ISAM by the Informix Corporation. SQL is based on ISO 9075 (ANSI X3.135-1986), but contains extensions and deviations (see Section 6.2.1.2).

(U) Hardware includes media and formats defined for transferring source code in machine-readable form. The features include 40- and 80-track 5 1/4-inch floppy disks, 1/2-inch magnetic tape, and utilities for transferring files. The primary magnetic tape format is 9-track, phase-encoded at 1,600 bits per inch.

(U) Networking is based on ISO standards and interim standards recommended by SPAG. X/OPEN is working to develop definitions in three areas where there are not yet standards:

- Generalised inter-process communications, with detailed definitions for message passing between processes, shared memory, and semaphores
- Distributed file system
- Distributed transaction processing.

8.3.3 Applications Portability Profile

(U) This section discusses the Applications Portability Profile developed by the U.S. National Bureau of Standards. The NBS approach to applications portability is based on recognition of the need for an architectural approach that provides interfaces for functionality to accommodate a broad range of applications requirements. The functional components of the architecture are viewed as a "tool box" of standard elements that can be used to develop and maintain portable applications. These tools are based on an open systems concept and are required to be developed as an integrated collection of nonproprietary standards.

(U) Figure 10 provides a high-level view of the architectural approach that underlies the Applications Portability Profile. The shaded area in Figure 10 identifies the primary elements of the profile: an operating system interface (POSIX), data base management, data interchange, network services, user interface, and programming services. The network services contain elements to support an open systems interconnection for data communications and to support file management. Database management services include both database languages and support for developing and maintaining data dictionaries. Programming services include programming languages. POSIX is shown as the operating system interface that enables the other elements of the profile to be essentially isolated from specific operating systems and hardware. The user interface provides support for windowing and menus, and the data interchange functions support business graphics, engineering graphics, and document processing. Applications make use of standard, nonproprietary interfaces to the functions provided by the profile. Figure 10 does not represent all possible interfaces among the elements of the profile, nor does it show all the ways a user can access these elements. For example, a user would normally execute applications via the user interface or the data interchange functions, but clearly some applications require no special interface. Further, users can be expected to need direct access to the data management service.

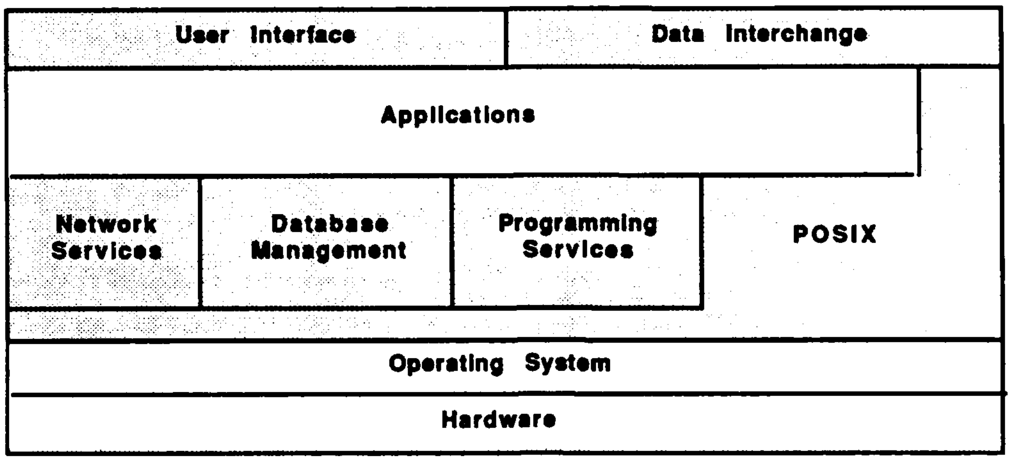

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Figure 10. (U) An Example View of the Architecture for the Applications Portability Profile

(U) Table 10 identifies the elements (tools) and the associated interface specifications of the recommended standards for the Applications Portability Profile. The key elements are: OSI for data communications; (extended) POSIX for the operating system interface; SQL and IRDS for database management; and XWindows for the user interface.

(U) An extended version of POSIX is recommended for the operating system interface (see Section 5.2.1). SQL Standard Database Language (see Section 6.2.1.2) and the IRDS data dictionary standard [Ref. 37] (see Section 6.2.4) are recommended for data base management. Recommended for data interchange are:

- Graphics Kernel System (GKS), used to define two-dimensional geometric primitives for constructing graphics pictures (ISO 7942 and ISO 8651); a three-dimensional extension of GKS is being defined (DP 8805, October 1985)
- Computer Graphics Metafile (CGM), used to define complete graphics pictures (ISO 8632)
- IGES, used for engineering graphics

- Standard Generalized Markup Language (SGML), a language used to define document applications (ISO 8879, DIS 9069, DIS 9070, DTR 9573)
- Office Document Architecture (ODA), a comprehensive architecture that includes a Document Processing Reference Model (ISO DIS 8613-3) for document layout; Document Profile (DIS 8613-4) for identifying, processing, and filing a document; Office Document Interchange Format (ODIF, DIS 8613-5) for defining the data stream for document interchange; Character Content Architectures (DIS 8613-6), Raster Graphic Content Architectures (DIS 8613-7), and Geometric Graphics Content Architecture (DIS 8613-8).

Standards and options identified in US GOSIP (see Section 8.3.1) are recommended for the open systems data communications, and Network File Service (NFS) is recommended for file management. XWindows is recommended for the user interface, providing a non-proprietary windowing capability. Five standard programming languages are recommended ("C", COBOL, FORTRAN, Ada, and Pascal), but standard bindings to POSIX for these languages are still being defined [Ref. 9, 38].

Table 10. (U) Standards for the Applications Portability Profile

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Function	Element	Reference for Standards
Operating System	Extended POSIX	IEEE P 1003.1+Extensions
Data Base Mgmt	SQL	IS 9075
	IRDS	ANSI X3.138
Data Interchange		
Business Graphics	GKS	ISO 7942, ISO 8651K, DIS 8805
	CGM	ISO 8632
Engineering Graphics	IGES	NBSIR 86-3359
Document Processing	SGML	ISO 8879, DIS 9079, DIS 9070, DTR 9573
	ODA/ODIF	DIS 8613
Network Services		
Data Communications	OSI	GOSIP (FIPS 146)
File Management	NFS	IEEE P1003.n
User Interface	XWindows	ANSI X3H3.6
Programming Services	C	ANSI X3J11/86-151-Oct 1986
	COBOL	ANSI X3.23-1974,85, FIPS 021-2
	FORTRAN	ANSI X3.9-1978, FIPS 069-1
	Ada	FIPS 119
	Pascal	ISO 7185-1983

(U) A review of the interface specifications for the Applications Portability Profile shows that there are not yet international standards for many of the elements of the recommended architecture. Some are being considered by ANSI, IEEE, and other standards defining bodies, and others are US standards. For example, XWindows, originally developed by the "X" Consortium at the Massachusetts Institute of Technology, is being considered by the X3H3.6 ANSI working group, and the "C" language bindings are being considered by the X3J11 ANSI working group. NBS is developing interim standards for file management and is recommending NFS to IEEE P1003 as the best starting point for these interfaces [Ref. 9].

8.3.4 Data Management

(U) Data management is an activity that recognizes three concepts for manual and automated information systems:

- Information and data used by organizations is relatively stable when compared to the processes used by the organization to perform its mission
- Data can be separated from the processes and applications that use the data, and the storage and management of data can be performed separately from the applications
- Data can be shared by many applications in a variety of functional areas.

Data standardization attempts to support data management by specifying the forms and structure for defining new data elements. Recent standardization activity with ISO and other standards defining bodies have focused on naming conventions.

(U) The U.S. Army has recently published an Army Regulation (AR 25-9) [Ref. 39] to prescribe policies, responsibilities, and concept of operation for the management of data used in manual and automated information systems throughout the U.S. Army. This document was coordinated with ISO, ANSI, and the U.S. National Bureau of Standards, as well as with the U.S. Joint Chiefs of Staff, to ensure alignment in the area of a data element naming convention. The Army plans to maintain a Service-wide data encyclopedia of information about all data elements that have gone through a standardization process and designated as Army standard elements. AR 25-9 addresses six activities that form the Army Data Management and Standards Program:

- Strategic data planning, the development and maintenance of data-related initiatives in integrated organizational multiyear long-range plans

- Data element standards, the standardization and management of data elements and their attributes
- Information management control, the interface between data management and control of the collection and reporting of management information requirements
- Data security, the policies and procedures required to protect and safeguard data and information, including operational security
- Data synchronization, the policies and procedures that govern the consistency, accuracy, reliability, and timeliness of data used and generated by the Army
- Data base development and maintenance, the policies and standards that guide design, development, documentation, and integration of data bases.

(U) AR 25-9 provides for three types of standard elements: reference element, data element, and data element alias. A reference element is a structure used to specify the domain or the range of acceptable values. A data element consists of a data element name, together with attributes describing what it is, its representation, and relationships to other objects. The data element name includes the name of the reference element that has the appropriate range of acceptable values. Note that it is the structure of a data element that is standardized, not the use of a data element. Data element aliases identify data elements in use in specific systems and locations, and they are used, temporarily, to bridge the gap between standard elements and nonstandard names being used in fielded systems.

9. CONCLUSIONS

(U) To be provided.

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APPENDIX A

THE USE OF INTEROPERABILITY PARAMETERS TO ENSURE STANDARDS COVERAGE

THE USE OF INTEROPERABILITY PARAMETERS TO ENSURE STANDARDS COVERAGE

1. INTRODUCTION

1.1 General

(U) This section describes a methodology for assuring adequate standards coverage through detailed analysis of the parameters that are required to achieve interoperability against specific standards that control these parameters.

1.2 Description of the Methodology

(U) An Interoperability Parameter (IP) is a system or design parameter whose control is required to achieve interoperability. These parameters are identified in system specifications, interface control documents, and other requirements documents prior to or very early in the system development process. In many cases, the interoperability parameters are controlled through the specification of a range of standards. The assembled parameters act as a checklist for interoperability, since each IP must be controlled by a suitable standard. The purpose of an analysis using IPs is to recognize and examine all relevant quantities and characteristics in a direct manner, instead of assuming that existing or draft standards will provide adequate coverage of the quantities.

(U) IPs can be identified and appropriately controlled in any stage of system development, from initial concepts and requirements to detailed design and as-built specifications. Parameters may simply be the identity of governing specifications (e.g., standards) for interface or other requirements. They could be the identity of options or specification of limits on performance requirements. They could include lists of services or routines that are mandated or that are denied for use. IPs may include logical or physical layouts that show such elements as sequences, relationships, interconnections, and logical block diagrams. IPs may include waveforms. They may include operating procedures, such as dial settings. In short, IPs include any information item that needs to be controlled at any stage of development to ensure interoperability.

(U) One of the underlying principles for the ATCCIS concept is that specifying standards is essential to ensuring interoperability. However, it cannot be too strongly emphasized that specifying standards alone will not guarantee interoperability. Indeed, every standard has a number of design parameters or IPs whose values may need to be fixed in the design phase of implementation. To ensure interoperability, each of these IPs must also be specified and controlled. Some IPs are very general and may be used to specify a class of options or mode of operation. Other IPs may be very detailed, such as restrictions on timing, format size, or bandwidth.

(U) Because each standard is a reflection of the degree to which agreement can be reached in a service area, many important attributes (i.e., IPs) are often left unspecified or unaddressed. As agreements are reached over time, the standards will improve by addressing more functionality and harmonizing conflicting approaches. In cases where standards identify extensions and other types of options, great care must be taken in standards specification and IP control to ensure that, whenever an extension or option is permitted, every implementation of the related service also supports this extension or option. This principle is especially important in achieving not only interoperability but also portability of applications from one implementation or environment to another, such as is needed when operating systems, data management systems, interface packages, and hardware are upgraded.

1.3 Examples of Interoperability Parameters

(U) A brief introduction to interoperability parameters is provided in this section by examining portions of three sets of standards:

- Physical standards for 25-pin connectors (i.e., EIA RS-232 interface)
- Electrical characteristics of digital interface circuits (i.e., QSTAG 594)
- Transmission characteristics for single channel radio (i.e., STANAG 4202).

1.3.1 Physical standards for 25-pin connectors

(U) Table A-1 identifies a number of electrical and mechanical interoperability parameters controlled by EIA RS-232D for 25-pin connectors. The first two columns provide the definition of the interoperability parameter, and the values specified in the standard, if any, are given in the third column.

Table A-1. (U) Example Interoperability Parameters Based on Characteristics of Unbalanced Load Digital Interface Circuits, 25-Pin Interface Connectors

UNCLASSIFIED

Description of Interoperability Parameter		Example Value of IP
EXAMPLE ELECTRICAL CHARACTERISTICS:		
Undefined condition	Minimum voltage Maximum voltage	-3 volts +3 volts
Marking condition (binary ONE)	Interface Voltage Maximum	-3 volts
Spacing condition (binary ZERO)	Interface Voltage Minimum	+3 volts
Restriction on use of hysteresis techniques to enhance noise immunity		None
Load impedance of the receiver side	Minimum for applied voltage ≤ 25 volts Maximum for applied voltage of 3 to 25 volts	3,000 ohms 7,000 ohms
Effective shunt capacitance of receiver	Maximum	2,500 picofarads
EXAMPLE MECHANICAL CHARACTERISTICS:		
Number of Pins		25
Cable length	Maximum	Not specified
Connector length (male contacts, female shell)	Minimum Maximum	38.84 mm 39.09 mm
Connector width (male contacts, female shell)	Minimum Maximum	8.23 mm 8.48 mm
Contact spacing, Pin #1	Longitudinal offset Lateral offset	+16.56 mm +1.42 mm
Contact spacing, Pin #2	Longitudinal offset Lateral offset	+15.19 mm -1.42 mm
Contact spacing, Pin #25	Longitudinal offset Lateral offset	-16.56 mm +1.42 mm
Pin diameter	Minimum Maximum	0.98 mm 1.06 mm
Pin length, overall with mounting	Minimum Maximum	9.77 mm 10.03
Pin mounting length	Minimum Maximum	1.57 mm 1.76 mm

Table A-1. (U) Example Interoperability Parameters Based on Characteristics of Unbalanced Load Digital Interface Circuits, 25-Pin Interface Connector (Continued)

UNCLASSIFIED

Description of Interoperability Parameter		Example Value of IP
Female contact length, overall with mounting	Minimum	9.27 mm
	Maximum	9.63
Female contact socket depth	Minimum	7.37 mm
	Maximum	7.37 mm
Pin assignment	Pin #1	Shield
	Pin #2	Transmitted Data (BA)
	Pin #5	Clear to Send (CA)
	Pine #25	Test Mode (TM)
Female contact socket depth	Minimum	7.37 mm
	Maximum	7.37 mm

Sources:

(1) DIS 2110, *25-Pin DTE/DCE Interface Connector and Pin Assignments* (related to EIA RS-232C), November 1985.

(2) EIA RS-232D, *Interface Between Data Terminal Equipment and Data Circuit-Terminating Equipment Employing Serial Binary Data Interchange*, 1986.

(3) EIA RS-449, *General Purpose 37-Position and 9-Position Interface for Data Terminal Equipment and Data Circuit-Terminating Equipment Employing Serial Binary Data Interchange*, November 1977.

(4) EIA Industrial Electronics Bulletin IEB-12, *Application Notes on Interconnection Between Interface Circuits Using RS-449 and RS-232C*, November 1977.

1.3.2 Electrical Characteristics of Digital Interface Circuits

(U) Table A-2 identifies interoperability parameters of digital interface circuits that are controlled by QSTAG 594. These are all electrical characteristics.

Table A-2. (U) Example Interoperability Parameters Based on Electrical Characteristics of Unbalanced Load Digital Interface Circuits

UNCLASSIFIED

Description of Interoperability Parameter		Example Value of IP
Open circuit voltage, generator	Minimum magnitude Maximum magnitude	4 volts 6 volts
Test termination voltage, generator	450 ohm ±1% test load min	90% magnitude of open circuit voltage
Short circuit current, generator	Maximum magnitude	150 mA
Output leakage current, current, generator	Maximum magnitude with applied voltage from -6 V to +6 V	100 μA
Output signal waveform voltage	Minimum magnitude Maximum magnitude Variance between transitions	3.6 volts 6 volts Within 10% steady state
Output signal waveshaping	Rise time to 90% steady state at maximum signaling rate Minimum Maximum Rise time to 90% steady state at signaling rates below 1 kb/s Minimum Maximum	 0.1 unit interval 0.3 unit interval 100 μsec 300 μsec
High impedance state	Requirement Output voltage at high imped and 450 ohm ±1% test load	Optional Zero (nominal)
Wire or cable	Characteristics	Not addressed
Signaling rates		Not specified
Total load	Resistance minimum Required differential input voltage to achieve intended binary state	400 ohms 200 mV
Fail safe	Requirement	Optional

Sources:

(1) QSTAG 594, *Electrical Characteristics of Digital Interface Circuits*, 25 March 1981 (adopts MIL-STD-188-114).

(2) MIL-STD-188-114A, *Electrical Characteristics of Digital Interface Circuits*, 30 September 1985 (Revision of MIL-STD-188-114 dated 24 March 1976).

(3) CCITT V.10/X.26, *Electrical Characteristics for Unbalanced Double-Current Interchange Circuits for General Use with Integrated Circuit Equipment in the Field of Data Communications*, 1985 (related to EIA RS-423A, which is compatible with MIL-STD-188-114A).

(4) EIA RS-423A, *Electrical Characteristics of Unbalanced Voltage Digital Interface Circuits*, December 1978.

1.3.3 Transmission Characteristics for Single Channel Radio

(U) Table A-3 presents a nearly complete summary of the interoperability parameters controlled by STANAG 4202 for single channel radios. This standard is in use as the basis of interoperability for digital data transmission on combat net radio.

Table A-3. (U) Example Interoperability Parameters Based on Single Channel Radio Standards (STANAG 4202)

UNCLASSIFIED

Description of Interoperability Parameter		Example Value of IP
Frequency Band	Minimum frequency Maximum frequency Channel spacing	Not specified Not specified Not specified
Transmission rates (1)	Preferred rate Other required rates	600 b/s 300, 1,200 (and 150 for HF)
Modulation	Type	FSK
Data	Character coding type	NATO 7-bit
FSK modulation	Mark (or 1) frequency Space (or 0) frequency Audio tone frequency accuracy, transmit Receiver accuracy	1575 Hz 2425 Hz ± 5 Hz (± 1 Hz desired) ± 20 Hz
FSK transition between mark & space	Maximum phase discontinuity	5 degrees
FSK timing	Minimum clock accuracy for synchronous data	± 1 part in 10**5
Keytime delay	Required Options Modulation applied	0.53333, 2.026676 sec Multiples of 0.10667 sec (2) Reversals ending in a zero
Bit synchronization preamble	Length Modulation	33 bits Reversals ending in a "1"
Character synchronization preamble	Length Modulation	63 bits Pseudo-random sequence gen. by a (6,1) shift register starting with "111111"

Notes:

(1) STANAG 4202 (Appendix B) provides guidelines for interim use of 16,000 b/s channels that are not shown in this table.

(2) 0.10667 sec is the time to send 128 bits at 1,200 b/s or 64 bits at 600 b/s.

Table A-3. (U) Example Interoperability Parameters Based on Single Channel Radio Standards (STANAG 4202) (Continued)

UNCLASSIFIED

Description of Interoperability Parameter		Example Value of IP
Message preparation for transmission	Initial character	"SI" or "NUL" (clear, respectively, encrypted text follows)
	Message structure	7-bit bytes
	Message padding	Up to 6 "1" bits
Cyclic redundancy check (applied to the entire input message)	CRC type	Polynomial
	Generator (mod 2)	x**16+x**12+x**5+1
	Conversion to 8-bit byte	0 in most significant bit
	Size of check	Three 7-bit bytes
	CRC padding	NATO 7-bit end-of-text chars as required (up to 15) (3)
Envelope termination	Size	Four 7-bit characters NATO 7-bit end-of-text chars
Error detection and correction coding (applied to 7-bit bytes)	ED&C type	Hamming (12,7), produces 12-bit coding for every 7-bit byte
Time dispersal coding (applied to 7-bit bytes)	TDC interleaving array size	16x12, with sixteen 12-bit Hamming codes
Errors	Number of acceptable but uncorrectable errors	None (stop processing and send no NACK)

Notes (Continued):

(3) The minimum message is 16x7 or 112 bits and requires 0.19 sec at 600 b/s.

Source:

STANAG 4202 EL (Edition 2), *Transmission Envelope Characteristics for High Reliability Data Exchange Between Land Tactical Data Processing Equipment Over Single Channel Radio Links,* Military Agency for Standardization, NATO, 25 May 1988.

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APPENDIX B

INTERNATIONAL STANDARDS RELEVANT TO ATCCIS

APPENDIX B: INTERNATIONAL STANDARDS RELEVANT TO ATCCIS

I. OSI GENERAL STANDARDS

OSI BASIC REFERENCE MODEL AND CONVENTIONS:

ISO[1] 7498	OSI--Basic Reference Model	
	AD[2] 1	Addendum 1: Connectionless-Mode Transmission
DIS[3] 7498-2	OSI Reference Model--Part 2: Security Architecture	
DIS 7498-3	OSI Reference Model--Part 3: Naming and Addressing	
DIS 7498-4	OSI Reference Model--Part 4: Management Framework	
SC 21 N2740	Register of Approved Commentaries on the Basic Reference Model for OSI	
TR[4] 8509	OSI--Service Conventions	
DTR[5] 9575	OSI Routing Framework	
CCITT X.210	OSI Layer Service Definition Conventions	
STANAG 4250	NATO Reference Model for OSI	

OSI DIRECTORY:

DIS 9594-1	The Directory--Part 1: Overview of Concepts, Models, and Service
DIS 9594-2	The Directory--Part 2: Models
DIS 9594-3	The Directory--Part 3: Abstract Service Definitions
DIS 9594-4	The Directory--Part 4: Procedures for Distributed Operations
DIS 9594-5	The Directory--Part 5: Protocol Specifications

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1 ISO: International Standard with final approval from ISO.

2 AD: Addendum for ISO standard

3 DIS: Draft International Standard for ISO.

4 TR: Technical Report for ISO.

5 DTR: Draft Technical Report for ISO.

DIS 9594-6	The Directory--Part 6: Selected Attribute Types
DIS 9594-7	The Directory--Part 7: Selected Object Classes
DIS 9594-8	The Directory--Part 8: Authentication Framework

OSI MANAGEMENT:

DP 9595-1	Management Information Service Definition--Part 1: Overview (draft proposal was withdrawn)
DP 9595-2	Management Information Service Definition--Part 2: Common Management Information Service Definition
DP 9596-1	Management Information Protocol Specification--Part 1: Overview
DP 9596-2	Management Information Protocol Specification--Part 2: Common Management Information Protocol
SC21 N2683	Systems Management: Overview (First Enhanced Working Draft, April 1988)
SC21 N2684	Management Information Services--Structure of Management Information (April 1988)
SC21 N2685	Management Information Services--Generic Definitions of Management Information (GDMI)
SC21 N2686	Working Draft of the OSI Management Specification--Part x: Configuration Management (June 1988)
SC21 N2687	Systems Management--Part x: Fault Management (Fifth Working Draft, June 1988)
SC21 N2689	Part x: Accounting Management Functional Area Specification
SC21 N2673	Part x: Performance Management Functional Area Specification
SC21 N2688	Management Information Services Definition--Part 7: Security Management Service Definition (Fourth Draft, September 1987)

OSI REGISTRATION AUTHORITIES:

DP[6] 9834-1	OSI--Procedures for Specific OSI Registration Authorities--Part 1: General Procedures
DP 9834-2	OSI--Procedures for Specific OSI Registration Authorities--Part 2: Registration Procedures for OSI Document Types
DP 9834-3	OSI--Procedures for Specific OSI Registration Authorities--Part 3: International Register of Object Identifier Component Values for Joint ISO-CCITT Use

6 DP: Draft Proposal for ISO standard.

DP 9834-4	OSI--Procedures for Specific OSI Registration Authorities--Part 4: Register of VTE-Profiles
DP 9834-5	OSI--Procedures for Specific OSI Registration Authorities--Part 5: Register of VT Control Objects

OSI CONFORMANCE TESTING:

DP 9646-1	OSI Conformance Testing Methodology and Framework--Part 1: General Concepts
DP 9646-2	OSI Conformance Testing Methodology and Framework--Part 2: Abstract Test Suite Specification
SC21 N2001	OSI Conformance Testing Methodology and Framework--Part 2: Abstract Test Suite Specification, Addendum: Testing and FDTs (working draft, June 1987)
DP 9646-3	OSI Conformance Testing Methodology and Framework--Part 2:
DP 9646-4	OSI Conformance Testing Methodology and Framework--Part 2: Test Realization
DP 9646-5	OSI Conformance Testing Methodology and Framework--Part 2: Requirements on Test Laboratories and Clients for the Conformance Assessment Process
DP 10025	Transport Conformance Testing for Connection Oriented Transport Protocol Operating Over the Connection Oriented Network Service--Part 1: General Principles

TAXONOMY AND PROFILES:

SC6 N4989	Taxonomy Framework and Directory of Profiles and ISPs

II. LAYER 1: PHYSICAL LAYER

GENERAL:

DP 10022	Physical Service Definition
STANAG 4251	NATO Reference Model for OSI - Layer 1 (Physical Layer) Service Definition
STANAG 4261	NATO Reference Model for OSI - Layer 1 (Physical Layer) Protocol Specification

MECHANICAL:

DIS 2110	25-Pin DTE/DCE Interface Connector and Pin Assignments (Revision of ISO 2110)
ISO 2593	34-Pin DTE/DCE Interface Connector and Pin Assignments
DIS 4902	37-Pin DTE/DCE Interface Connector and Pin Assignments (Revision of ISO 4902)
DIS 4903	15-Pin DTE/DCE Interface Connector and Pin Assignments (Revision of ISO 4903)
TR 7477	Arrangements for DTE/DTE Physical Connection Using V.24 and X.24 Interchange Circuits
ISO 8481	DTE/DTE Physical Connection Using X.24 Interchange Circuits with DTE-Provided Timing
DIS 8482	Twisted Pair Multipoint Interconnections
ISO 8877	Interface Connector and Contact Assignments for ISDN Basic Access Interface Located at Reference Points S and T
	PDAD[7]1 Addendum 1: Standard ISDN Basic Access TE Connecting Cord
CCITT I.340	ISDN Connection Types

ELECTRICAL:

CCITT I.430	Basic User-Network Interface--Layer 1 Specification (ISDN)

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7 PDAD: Preliminary Draft Addendum to ISO standard.

CCITT I.431	Primary Rate User-Network Interface--Layer 1 Specification (ISDN)
CCITT V.5	Data Signalling Rates for Synchronous Data Transmission in the General Switched Telephone Network
CCITT V.6	Data Signalling Rates for Synchronous Data Transmission on Leased Telephone-Type Circuits
CCITT V.10/X.26	Electrical Characteristics for Unbalanced Double-Current Interchange Circuits for General Use with Integrated Circuit Equipment in the Field of Data Communication
CCITT V.11/X.27	Electrical Characteristics for Balanced Double-Current Interchange Circuits for General Use with Integrated Circuit Equipment in the Field of Data Communications
CCITT V.28	Electrical Characteristics for Unbalanced Double-Current Interchange Circuits
CCITT V.31	Electrical Characteristics for Single-Current Interchange Circuits Controlled by Contact Closure
CCITT V.31 bis	Electrical Characteristics for Single-Current Interchange Circuits Using Opto Couplers
CCITT V.35	Data Transmission at 48 Kilobits per Second Using 60-108 kHz Group Band Circuits

FUNCTIONAL:

ISO 7480	Start-Stop Transmission Signal Quality at DTE/DCE Interfaces
DIS 9543	Synchronous Transmission Signal Quality at DTE/DCE Interfaces
CCITT I.411	ISDN User-Network Interfaces--Reference Configuration
CCITT I.412	ISDN User-Network Interfaces--Interface Structures and Access Capabilities
CCITT X.1	International User Classes of Service in Public Data Networks and Integrated Services Digital Networks (ISDNs)
CCITT X.4	General Structure of Signals of International Alphabet
	No. 5 Code for Data Transmission Over Public Data Networks
CCITT X.10	Categories of Access for DTE to Public Data Transmission Services Provided by PDNs and/or ISDNs through Terminal Adaptors
CCITT X.24	List of Definitions for Interchange Circuits Between DTE and DCE on Public Data Networks

PROCEDURAL:

CCITT I.420	Basic User-Network Interface (ISDN)
CCITT I.421	Primary Rate User-Network Interface (ISDN)
CCITT I.430	Basic User-Network Interface--Layer 1 Specification (ISDN)
CCITT I 460	Multiplexing, Rate Adaptation and Support of Existing Interfaces (ISDN)
CCITT I.461	Support of X.21 AND X.21 bis Based DTEs by ISDN
CCITT I.462	Support of Packet Mode Terminal Equipment by an ISDN
CCITT I.463	Support of DTEs with V-Series Type Interfaces by an ISDN
CCITT I.464	Multiplexing Rate Adaptation and Support of Existing Interfaces for Restricted 64 kbit/s Transfer Capability
CCITT V.24	List of Definitions for Interchange Circuits Between DTE and DCE
CCITT V.25	Automatic Answering Equipment and/or Parallel Automatic Calling Equipment on the General Switched Telephone Network Including Procedures for Disabling of Echo Control Devices for both Manually and Automatically Established Calls
CCITT V.54	Loop Test Devices for Modems
CCITT X.20	Interface Between DTE and DCE for Start-Stop Transmission Services on Public Data Networks
CCITT X.20 bis	Use on Public Data Networks of DTE Which Is Designed for Interfacing to Asynchronous Duplex V-Series Modems
CCITT X.21	Interface Between DTE and DCE for Synchronous Operation on Public Data Networks
CCITT X.21 bis	Use on Public Data Networks of DTE Which Is Designed for Interfacing to Synchronous V-Series Modems
CCITT X.22	Multiplex DTE/DCE Interface for User Classes 3-6
CCITT X.150	Principles of Maintenance Testing for Public Data Networks Using DTR and DCE Test Loops
DIS 8480	DTE/DCE Back-Up Control Operation Using the 25-Pole Connector
ISO 9067	Automatic Fault Isolation Procedures Using Test Loops

ISSUES: Type equipment, interfaces; media; electrical balance; data transmission rate; synchronicity

III. LAYER 2: DATA LINK LAYER

GENERAL:

DIS 8886.3[8]	Data Link Service Definition for OSI
STANAG 4252	NATO Reference Model for OSI - Layer 2 (Data Link Layer) Service Definition
STANAG 4262	NATO Reference Model for OSI - Layer 2 (Data Link Layer) Protocol Specification

CHARACTER ORIENTED SERVICE (BASIC MODE):

ISO 1745	Basic Mode Control Procedures for Data Communication Systems
ISO 2111	Basic Mode Control Procedures--Code Independent Information Transfer
ISO 2628	Basic Mode Control Procedures--Complements
ISO 2629	Basic Mode Control Procedures--Conversational Information Message Transfer

BIT ORIENTED SERVICE (HIGH-LEVEL DATA LINK CONTROL PROCEDURES [HDLC]):

ISO 3309	HDLC--Frame Structure	
	PDAD 1	Addendum 1: Start/Stop Transmission
ISO 4335	HDLC--Consolidation of Elements of Procedures	
	PDAD 1	Addendum 1: Asynchronous (Start/Stop) Transmission Operation
	PDAD 2	Addendum 2: Enhancement of the XID Function Utility
	PDAD 3	Addendum 3: Start/Stop Transmission
ISO 7478	Multilink Procedures	

8 For ISO standards, the decimal indicates the version number; thus, DIS 8886.3 is Version 3 (no decimal indicates Version 1).

ISO 7776	HDLC--Description of the X.25 LAPB-Compatible DTE Data Link Procedures	
ISO 7809	HDLC--Consolidation of Classes of Procedures	
	AD 1	Addendum 1: UI Command/Response
	AD 2	Addendum 2: Descriptions of Optional Functions
	PDAD 3	Addendum 3: Stop/Start Transmission
	PDAD 4	Addendum 4: List of Standard Data Link Layer Protocols that Utilize HDLC Classes of Procedures
ISO 8471	HDLC Balanced Classes of Procedures-- Data Link Layer Address Resolution/Negotiation in Switched Environments	
ISO 8885	HDLC--General Purpose XID Frame Information Field Content and Format	
	DAD[9] 1	Addendum 1: .Additional Operational Parameters for the Parameter Negotiation Data Link Layer Subfield and Definition of a Multilink Parameter Negotiation Data Link Layer Subfield
	PDAD 2	Addendum 2: Stop/Start Transmission
CCITT I.440	ISDN User-Network Interface Data Link Layer--General Aspects	
CCITT I.441	ISDN User-Network Interface Data Link Layer Specification	
CCITT T.71	LAPB Extended for Half-Duplex Physical Level Facility	

LOCAL AREA NETWORKS (LANs):

DP 8802-1	LANs--Part. 1: General Introduction	
DIS 8802-2.2	LANs--Part. 2: Logical Link Control	
	DAD 1	Addendum 1: Flow Control Techniques for Bridged LANs
DIS 8802-3	LANs--Part. 3: Carrier Sense Multiple Access with Collision Detection (CSMA/CD)--Access Method and Physical Layer Specifications	
	DAD 1	Addendum 1: Medium Attachment Unit and Baseband Medium Specifications for Type 10BASE2
	DAD 2	Addendum 2: Repeater Set and Repeater Unit Specification for Use with 10BASE5 and 10 BASE2 Networks
	PDAD 3	Addendum 3: Broadband Medium Attachment Unit and Broadband Medium Specifications, Type 10BROAD36

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9 DAD: Draft Addendum to ISO standard.

DIS 8802-4	LANs--Part. 4: Token-Passing Bus Access Method and Physical Layer Specifications
DIS 8802-5	LANs--Part. 5: Token Ring Access Method and Physical Layer Specifications
DIS 8802-7	LANs--Part. 7: Slotted Ring Access Method and Physical Layer Specifications
PDTR 9578	Communication Interface Connectors Used in LANs

ERROR CORRECTION:

CCITT X.141	General Principles for the Detection and Correction of Errors in Public Data Networks

ISSUES: Character/bit orientation; single or multiple link; circuit or packet switched; use of LANs?

IV. LAYER 3: NETWORK LAYER

GENERAL:

ISO 8348	Network Service Definition	
	AD 1	Addendum 1: Connectionless Mode Transmission
	AD 2	Addendum 2: Network Layer Addressing
	DAD 3	Addendum 3: Additional Features of the Network Service
ISO 8648	Internal Organization of the Network Layer	
PDTR[10] 9577	Protocol Identification in the OSI Network Layer	
DIS 8880-1	Protocol Combination to Provide and Support the OSI Network Service - Part. 1: General Principles	
DIS 8880-2	Protocol Combination to Provide and Support the OSI Network Service - Part. 2: Provision and Support of the Connection-Mode Network Service	
DIS 8880-3	Protocol Combination to Provide and Support the OSI Network Service - Part. 3: Provision and Support of the Connectionless-Mode Network Service	
DP 10028	Definition of the Relaying Functions of a Network Layer Intermediate System	
CCITT T.70	Network-Independent Basic Transport Service for the Telematic Services	
CCITT X.213	Network Service Definition for OSI for CCITT Applications	
STANAG 4253	NATO Reference Model for OSI - Layer 3 (Network Layer) Service Definition	
STANAG 4263	NATO Reference Model for OSI - Layer 3 (Network Layer) Protocol Specification	

[10] PDTR: Preliminary Draft Technical Report for ISO.

PACKET-SWITCHED SERVICE:

ISO 8208 — X.25 Packet Level Protocol (PLP) for DTE

- DAD 1 — Addendum 1: Alternative Logical Channel Number Allocation
- PDAD 2 — Addendum 2: Extensions for Private Switched Use
- PDAD 3 — Addendum 3: Conformance Requirements

ISO 8878 — Use of X.25 to Provide the OSI Connection-Mode Network Service

DIS 8881.3 — Use of the X.25 PLP in LANs

DIS 8882-1 — X.25-DTE Conformance Testing - Part 1: General Principles

DIS 8882-2 — X.25-DTE Conformance Testing - Part 2: Data Link Conformance Test Suite

DIS 8882-3 — X.25-DTE Conformance Testing - Part 3: Packet Level Conformance Test Suite

CCITT X.25 — Interface Between DTE and DCE for Terminals Operating in the Packet Mode and Connected to Public Data Networks by Dedicated Circuit

CCITT X.244 — Procedure for the Exchange of Protocol Identification During Virtual Call Establishment on Packet Switched Public Data Networks

CONNECTIONLESS SERVICE:

DIS 8473 — Protocol for Providing the Connectionless Mode Network Service

- PDAD 1 — Addendum 1: Provision of the Underlying Service Assumed by ISO 8473 over Point-to-Point Subnetworks which Provide the OSI Data Link Service
- PDAD 2 — Addendum 2: Formal Description of ISO 8473
- DAD 3 — Addendum 3: Provision of the Underlying Service Assumed by ISO 8473 over Subnetworks which Provide the OSI Data Link Service

DP 9068 — Provision of the Connectionless Network Service Using ISO 8208

DIS 9542 — End System to Intermediate System Routing Exchange Protocol for Use in Conjunction with the Protocol for Providing the Connectionless Mode Network Service

ISDN:

CCITT I.450 — ISDN User-Network Interface--Layer 3-General Aspects

CCITT I.451 — ISDN User-Network Interface--Layer 3-Specification

Note: Additional ISDN standards are listed in the last section of this Appendix.

ROUTING:

SC6 N5006	End System to Intermediate System Routing Exchange Protocol for Use in Conjunction with ISO 8208 (X.25 PLP)
CCITT X.110	International Routing Principles and Routing Plan for Public Data Networks
CCITT X.353	Routing Principles for Interconnecting the Maritime Satellite-Data Transmission System with Public Data Networks

CIRCUIT SWITCHED SERVICE:

Covered by CCITT	X.21, X.24, X.26, X.27, ISO 4903, listed under Physical Layer Standards.

ISSUES: Packet/circuit switching; connection/connectionless service

V. LAYER 4: TRANSPORT LAYER

GENERAL:

DIS 8072	OSI--Transport Service Definition
	AD 1 Addendum 1: Connectionless-Mode Transmission
CCITT X.214	Transport Service Definition for OSI for CCITT Applications
CCITT T.70	Network-Independent Basic Transport Service for the Telematic Services
STANAG 4254	NATO Reference Model for OSI - Layer 4 (Transport Layer) Service Definition
STANAG 4264	NATO Reference Model for OSI - Layer 4 (Transport Layer) Protocol Specification

CONNECTION-ORIENTED SERVICE:

ISO 8073	OSI--Connection Oriented Transport Protocol Specification
	DAD 1 Addendum 1: Network Connection Management Subprotocol
	PDAD 3 Addendum 3: Protocol Implementation Conformance Statement Proforma
CCITT X.224	Transport Protocol Specification for OSI for CCITT Applications

CONNECTIONLESS SERVICE:

ISO 8073 DAD 2	Connection Oriented Transport Protocol Specification Addendum 2: Operation of Class 4 Over Connectionless Network Service
ISO 8602	Protocol for Providing the Connectionless-Mode Transport Service

ISSUES: Connection oriented versus connectionless service

VI. LAYER 5: SESSION LAYER

GENERAL:

ISO 8326	OSI--Basic Connection-Oriented Session Service Definition		
		DAD 1	Addendum 1: Session Symmetric Synchronization for the Session Service
		DAD 2	Addendum 2: Incorporation of Unlimited User Data
		DAD 3	Addendum 3: Connectionless Mode Session Service
CCITT X.215	Session Service Definition for OSI for CCITT Applications		
STANAG 4255	NATO Reference Model for OSI - Layer 5 (Session Layer) Service Definition		
STANAG 4265	NATO Reference Model for OSI - Layer 5 (Session Layer) Protocol Specification		

CONNECTION-ORIENTED SERVICE:

ISO 8327	OSI--Basic Connection-Oriented Session Protocol Specification		
		DAD 1	Addendum 1: Session Symmetric Synchronization for the Session Protocol
		DAD 2	Addendum 2: Incorporation of Unlimited User Data
CCITT T.62	Control Procedures for Teletex and Group 4 Facsimile Services		
CCITT T.72	Terminal Capabilities for Mixed Mode of Operation (?)		
CCITT X.225	Session Protocol Specification for OSI for CCITT Application		

CONNECTIONLESS SERVICE:

DIS 9548	OSI--Session Connectionless Protocol to Provide Connectionless-Mode Session Service

ISSUES: Connectionless/connectionless service; half/full duplex; mixed service modes (teletex, fax)?

VII. LAYER 6: PRESENTATION LAYER

GENERAL:

DIS 8822 — OSI--Connection-Oriented Presentation Service Definition

- PDAD 1 — Addendum 1: Connectionless Mode Presentation Service

DIS 8823 — OSI--Connection-Oriented Presentation Protocol Specification

- WDAM[11] 1 — Presentation Amendment for PICS Proforma
- PDAD 1 — Addendum 1: Presentation Protocol Implementation Conformance Statement

STANAG 4256 — NATO Reference Model for OSI - Layer 6 (Presentation Layer) Service Definition

STANAG 4266 — NATO Reference Model for OSI - Layer 6 (Presentation Layer) Protocol Specification

ABSTRACT SYNTAX NOTATION ONE (ASN.1):

DIS 8824 — OSI--Specification of ASN.1

- DAD 1 — Addendum 1: ANS.1 Extensions

DIS 8825 — Specification of Basic Encoding Rules for ASN.1

- DAD 1 — Addendum 1: ANS.1 Extensions

CONNECTIONLESS SERVICE:

DP 9576 — OSI--Presentation Connectionless Protocol to Provide Connectionless-Mode Presentation Service

SC 21 N1965 — OSI--Connectionless Presentation Service Definition

SC 21 N1966 — OSI--Connectionless Presentation Protocol Specification

Presentation Layer for Telematic Services: See standards under Application Layer.

ISSUES: Syntax language (ASN.1?); connection/connectionless service; necessity of this layer in system of interest

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[11] WDAM: Working Draft for Amendment to ISO standard.

VIII. LAYER 7: APPLICATION LAYER

GENERAL:

ISO 9545	OSI--Application Layer Structure (ALS)
STANAG 4257	NATO Reference Model for OSI - Layer 7 (Application Layer) Service Definition
STANAG 4267	NATO Reference Model for OSI - Layer 7 (Application Layer) Protocol Specification

ASSOCIATION CONTROL SERVICE ELEMENT (ACSE):

DIS 8649	Service Definition for the ACSE
	WDAD[12] 1 Addendum 1: Authentication
	PDAD 2 Addendum 2: A-UNIT-DATA-SERVICE
DIS 8650	Protocol Specification for the ACSE
	WDAD 1 Addendum 1: Authentication
DIS 9804.2	OSI--Service Definition for the Commitment, Concurrency and Recovery Service Element
DIS 9805.2	Protocol Specification for the Commitment, Concurrency and Recovery Service Element
SC 21 N1960	Connectionless Application Layer Service Definition
SC 21 N1961	Connectionless Application Layer Protocol Specification

MESSAGE HANDLING SYSTEM (MHS):

CCITT X.400	MHS-System Model and Service Elements (see DIS 10021-1 for MOTIS)
CCITT X.401	MHS-Basic Service Elements and Optional User Facilities (see DIS 10021-1 for MOTIS)
CCITT X.402	New for MHS-1988 (same as DIS 10021-2 for MOTIS)
CCITT X.403	New for MHS-1988 (no comparable ISO standard for MOTIS)
CCITT X.407	New for MHS-1988 (same as DIS 10021-3 for MOTIS)
CCITT X.409	Replaced by X.208 (ISO 8824 with DAD1) and X.208 (ISO 8825 with DAD1)

12 WDAD: Working Draft Addendum to ISO standard.

CCITT X.410	Replaced by X.218 (DIS 9066-1), X.219 (DIS 9072-1), X.228 (DIS 9066-2), and X.229 (DIS 9072-2)
CCITT X.411	MHS-Message Transfer Layer
CCITT X.413	New for MHS-1988 (same as DIS 10021-5 for MOTIS)
CCITT X.419	(same as DIS 10021-6 for MOTIS)
CCITT X.420	MHS-Interpersonal Messaging User Agent Layer (same as DIS 10021-7 for MOTIS)
CCITT X.430	Replaced by T.330 (no comparable standard for MOTIS)

MESSAGE ORIENTED TEXT INTERCHANGE SYSTEM (MOTIS):

DIS 10021-1	MOTIS Part 1: System and Service
DIS 10021-2	MOTIS Part 2: Overall Architecture
DIS 10021-3	MOTIS Part 3: Abstract Service Definition Conventions
DIS 10021-4	MOTIS Part 4: Message Transfer System--Abstract Service Definition and Procedures
DIS 10021-5	MOTIS Part 5: Message Store--Abstract Service Definition
DIS 10021-6	MOTIS Part 6: Protocol Specifications
DIS 10021-7	MOTIS Part 7: Interpersonal Message System
DIS 9066-1.2	Reliable Transfer--Part 1: Model, Notation and Service Definition
DIS 9066-2.2	Reliable Transfer--Part 2: Protocol Specification
DIS 9072-1.2	Remote Operations--Part 1: Concepts and Model
DIS 9072-2.2	Remote Operations--Part 1: Protocol Specification

FILE TRANSFER, ACCESS AND MANAGEMENT (FTAM):

DIS 8571-1	FTAM Part 1: General Introduction
DIS 8571-2	FTAM Part 2: Virtual Filestore Definition
DIS 8571-3	FTAM Part 3: File Service Definition
DIS 8571-4	FTAM Part 4: File Protocol Specification
DIS 8571-5	FTAM Part 5: Protocol Implementation Conformance Statement Proforma

GKS:

ISO 7942	Graphical Kernel System (GKS) Functional Description

ISO 8651-1	GKS Language Bindings--Part 1: FORTRAN
ISO 8651-2	GKS Language Bindings--Part 2: Pascal
ISO 8651-3	GKS Language Bindings--Part 3: Ada
DIS 8805	GKS for Three Dimensions (GKS-3D) Functional Description WDAD 1 Name Set Addendum

DOCUMENT EXCHANGE--ODA/ODIF:

ISO 8211	Specification for a Data Descriptive File for Information Interchange
DIS 8613-1	Office Document Architecture (ODA) and Interchange Format--Part 1: Introduction and General Principles
DIS 8613-2	ODA and Interchange Format--Part 2: Document Structures PDAD 1 Addendum 1: Formal Specification of ODA Document Structures
DIS 8613-3	ODA and Interchange Format--Part 3: Document Processing Reference Model
DIS 8613-4	ODA and Interchange Format--Part 4: Document Profile
DIS 8613-5	ODA and Interchange Format--Part 5: Office Document Interchange Format (ODIF)
DIS 8613-6	ODA and Interchange Format--Part 6: Character Content Architectures
DIS 8613-7	ODA and Interchange Format--Part 7: Raster Graphics Content Architectures
DIS 8613-8	ODA and Interchange Format--Part 8: Geometric Graphics Content Architectures
DP 10031-1	Distributed Office Applications Model--Part 1: General Model
DP 10031-2	Distributed Office Applications Model--Part 2: Referenced Data
SC18 N1264	Document Filing and Retrieval (DFR)--Part 1: Abstract Service Definition and Procedures (working draft, October 1987)
SC18 N1265	Document Filing and Retrieval (DFR)--Part 2: Protocol Specification (working draft, October 1987)

PICTURE DESCRIPTION INFORMATION EXCHANGE:

ISO 8632-1	Metafile for the Storage and Transfer of Picture Description Information--Part 1: Functional Specification
ISO 8632-2	Metafile for the Storage and Transfer of Picture Description Information--Part 2: Character Encoding

ISO 8632-3	Metafile for the Storage and Transfer of Picture Description Information--Part 3: Binary Encoding
ISO 8632-4	Metafile for the Storage and Transfer of Picture Description Information--Part 4: Clear Text Encoding

STANDARD GENERALIZED MARKUP LANGUAGE (SGML):

ISO 8879	Standard Generalized Markup Language (SGML)
DIS 9573	SGML Support Facilities--Techniques for Using SGML
DIS 9069	SGML Support Facilities--SGML Document Interchange Format (SDIF)
DIS 9070	SGML Support Facilities--Registration Procedures for Public Text Owner Identifiers

DISTRIBUTED TRANSACTION PROCESSING (TP):

DP 10026-1	Distributed TP--Part 1: Model
DP 10026-2	Distributed TP--Part 2: Service Definition
DP 10026-3	Distributed TP--Part 3: TP Protocol Specification

INFORMATION RESOURCE DICTIONARY SYSTEM (IRDS):

DP 8800-1	IRDS Part 1: Command Language and Panel Interface
DP 10027	IRDS Framework
SC21 N2132	IRDS Services Interface (Working Draft, Revision 4, September 1987)

DATABASE LANGUAGES AND CONCEPTS:

TR 9007	Concepts and Terminology for the Conceptual Schema and the Information Base
DP 10032	Reference Model of Data Management
DP 9579	Remote Database Access (RDA)
ISO 8907	Database Language NDL
ISO 9075	Database Language SQL
	DAD 1 Addendum 1:
DP 10035	A-UNIT-DATA Protocol

ISSUES: Which applications are required? (MHS, VTS, JTM, FTAM,etc.)

IX. MISCELLANEOUS

INTEGRATED SERVICES DIGITAL NETWORK (ISDN): GENERAL STANDARDS

DIS 9574	Provision of the OSI Connection Mode Network Service by Packet Mode Terminal Equipment Connected to an ISDN
CCITT I.110	General Structure of the I-Series Recommendations
CCITT I.111	Relationship with Other Recommendations Relevant to ISDNs
CCITT I.120	ISDNs
CCITT I.130	Attributes for the Characterization of Telecommunications Service Supported by an ISDN and Network Capabilities of an ISDN
CCITT I.210	Principles of Telecommunications Services Supported by and ISDN
CCITT I.211	Bearer Services Supported by an ISDN
CCITT I.212	Teleservices Supported by an ISDN
CCITT I.310	ISDN--Network Functional Principles
CCITT 320	ISDN Protocol Reference Model
CCITT 330	ISDN Numbering and Addressing Principles
CCITT I.331	Numbering Plan for the ISDN Era
CCITT I.410	General Aspects and Principles Relating to Recommendations on ISDN User-Network Interfaces

TELEMATIC SERVICES:

CCITT T.0	Classification of Facsimile Apparatus for Document Transmission Over the Public Networks

APPENDIX C

NUMERICAL LISTING OF ISO STANDARDS RELEVANT TO ATCCIS

NUMERICAL LISTING OF ISO STANDARDS RELEVANT TO ATCCIS[1]

ISO 1745, Information Processing - Basic Mode Control Procedures for Data Communication Systems, First Edition, February 1975 (FINAL).

ISO 2110, Data Communication - 25-Pin DTE/DCE Interface Connector and Pin Assignments, Second Edition, July 1980 (FINAL).

DIS 2110, Data Communication - 25-pin DTE/DCE Interface Connector and Pin Assignments, Revised November 1985 (DIS)

ISO 2111, Data Communication - Basic Mode Control Procedures - Code Independent Information Transfer, Second Edition, February 1985 (FINAL).

ISO 2593, Data Communication - 34-Pin DTE/DCE Interface Connector and Pin Assignments, Second Edition, February 1984 (FINAL)

ISO 2628, Basic Mode Control Procedures - Complements, First Edition, June 1973 (FINAL)

ISO 2629, Basic Mode Control Procedures - Conversational Information Message Transfer, First Edition February 1973 (FINAL)

ISO 3309, Information Processing Systems - Data Communication - High-level Data Link Control Procedures - Frame Structure, Third Edition, October 1984 (FINAL)

ISO 3309 PDAD 1, Information Processing Systems - Data Communication - High-level Data Link Control Procedures - Frame Structure - Addendum 1: Start/stop transmission, March 1988 (DP)

ISO 4335, Information Processing Systems - Data Communication - High-level Data Link Control Elements of Procedures, Third Edition, August 1987 (FINAL)

ISO 4335 PDAD 1, Information Processing Systems - Data Communication - High-level Data Link Control Procedures - Element of Procedures Addendum 1: Asynchronous (Start/Stop) Transmission Operation, December 1987 (DP)

ISO 4335 PDAD 3, Information Processing Systems - Data Communication - High-level Data Link Control Procedures - Element of Procedures - Addendum 1: Start/stop Transmission, March 1988 (DP)

ISO 4902, Data Communication - 37-Pin and 9-Pin DTE/DCE Interface Connectors and Pin Assignments, First Edition, December 1980, (FINAL)

DIS 4902, Data Communication - 37-Pin DTE/DCE Interface Connector and Pin Assignments, Revised Edition, November 1985 (DIS)

ISO 4903, Data Communication - 15-Pin DTE/DCE Interface Connector and Pin Assignments, First Edition, June 1980 (FINAL)

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[1] Provided by OMNICON, current as of 8 September 1988.

DIS 4903, Data Communication - 15-Pin DTE/DCE Interface Connector and Pin Assignments, Revised Edition, November 1985 (DIS)

ISO TR 7477, Data Communication - Arrangement for DTE to DTE Physical Connection Using V.24 and X.24 Interchange Circuits, Fist Edition, September 1985 (FINAL)

ISO 7478, Information Processing Systems - Data Communication - Multilink Procedures, First Edition, July 1987 (FINAL)

ISO 7480, Information Processing - Start-Stop Transmission Signal Quality at DTE/DCE Interfaces, First Edition, October 1984 (FINAL)

ISO 7498, Information Processing Systems - Open Systems Interconnection - Basic Reference Model, First Edition, October 1984 (FINAL)

ISO 7498 AD 1, Information Processing Systems - Open Systems Interconnection - Basic Reference Model - Addendum 1: Connectionless-Mode Transmission, July 1987 (FINAL)

DIS 7498-2, Information Processing Systems - Open Systems Interconnection Reference Model - Part 2: Security Architecture, July 1988 (DIS)

DIS 7498-3, Information Processing Systems - Open Systems Interconnection - Basic Reference Model - Part 3: Naming and Addressing, July 1988, (DIS)

DIS 7498-4, Information Processing Systems - Open Systems Interconnection - Basic Reference Model - Part 4: Management Framework, January 1988 (DIS)

ISO 7776, Information Processing Systems - Data Communication - High-level Data Link Control Procedures - Description of the X.25 LAPB-Compatible DTE Data Link Procedures, First Edition, December 1986 (FINAL)

ISO 7809, Information Processing Systems - Data Communication - High-level Data Link Control Procedures - Consolidation of Classes of Procedures, First Edition, February 1984 (FINAL)

ISO 7809 AD 1, Information Processing Systems - Data Communication - High-level Data Link Control Procedures - Consolidation of Classes of Procedures - Addendum 1, First Edition, June 1986 (FINAL)

ISO 7809 AD 2, Information Processing Systems - Data Communication - High-level Data Link Control Procedures - Consolidation of Classes of Procedures Addendum 2: Descriptions of Optional Functions, First Edition, June 1987 (FINAL)

ISO 7809 PDAD 3, Information Processing Systems - Data Communication - High-level Data Link Control Procedures - Classes of Procedures - Addendum 3: Start/stop Transmission, March 1988 (DP)

ISO 7809 PDAD 4, Information Processing Systems - Data Communication - High Level Data Link Control Procedures - Consolidation of Classes of Procedures - Addendum 4: List of Standard Data Link Layer Protocols that Utilize HDLC Classes of Procedures, March 1988 (DP)

ISO 7942, Information Processing Systems - Computer Graphics - Graphical Kernel System (GKS) Functional Description, First Edition, August 1985 (FINAL)

ISO 8072, Information Processing Systems - Open Systems Interconnection - Transport Service Definition, First Edition, June 1986 (FINAL)

ISO 8072 AD 1, Information Processing Systems - Open Systems Interconnection - Transport Service Definition - Addendum 1: Connectionless-mode Transmission, First Edition July 1986 (FINAL)

ISO 8073, Information Processing Systems - Open Systems Interconnection - Connection Oriented Transport Protocol Specification, First Edition, July 1986 (FINAL)

ISO 8073 DAD 1, Information Processing Systems - Open Systems Interconnection - Connection Oriented Transport Protocol Specification - Addendum 1: Network Connection Management Subprotocol, April 1988 (DIS)

ISO 8073 DAD 2, Information Processing Systems - Open Systems Interconnection - Connection Oriented Transport Protocol Specification - Addendum 2: Class Four Operation Over Connectionless Network Service, July 1987 (DIS)

ISO 8073 PDAD 3, Information Processing System - Open Systems Interconnection - Connection Oriented Transport Protocol Specification - Addendum 3: Protocol Implementation Conformance Statement Proforma, March 1988 (DP)

ISO 8208, Information Processing Systems - Data Communications - X.25 Packet Level Protocol for data Terminal Equipment, First Edition, September 1987 (FINAL)

ISO 8208 DAD 1, Information Processing Systems - X.25 Packet Level Protocol for Data Terminal Equipment - Addendum 1: Alternative Logical Channel Number Allocation, July 1986 (DIS)

ISO 8208 PDAD 2, Information Processing Systems - X.25 Packet Level Protocol for Data Terminal Equipment - Addendum 2 - Extensions for Private and Switched Use, January 1986 (DIS)

ISO 8208 PDAD 3, Information Processing Systems - Data Communications - X.25 Packet Level Protocol for Data Terminal Equipment - Addendum 3: Conformance Requirements, June 1986 (PDAD)

ISO 8211, Information Processing - Specification for a Data Descriptive File for Information Interchange, First Edition, December 1985 (FINAL)

ISO 8326, Information Processing Systems - Open Systems Interconnection - Basic Connection Oriented Session Service Definition, First Edition, August 1987 (FINAL)

ISO 8326 DAD 1, Information Processing Systems - Open Systems Interconnection - Basic Connection Oriented Session Service Definition - Addendum 1: Session Symmetric Synchronization for the Session Service, July 1987 (DAD)

ISO 8326 DAD 2, Information Processing Systems - Open Systems Interconnection - Basic Connection Oriented Session Service Definition - Addendum 2: Incorporation of Unlimited User Data, June 1988 (DIS)

ISO 8326 DAD 3, Information Processing Systems - Open Systems Interconnection - Basic Connection Oriented Session Service Definition - Addendum 3: Connectionless-mode Session Service, May 1988 (DAD)

ISO 8327, Information Processing Systems - Open Systems Interconnection - Basic Connection Oriented Session Protocol Specification, First Edition, August 1987 (FINAL)

ISO 8327 DAD 1, Information Processing Systems - Open Systems Interconnection - Basic Connection Oriented Session Protocol Specification - Addendum 1: Session Symmetric Synchronization for the Session Protocol, July 1987 (DIS)

ISO 8327 DAD 2, Information Processing Systems - Open Systems Interconnection - Basic Connection Oriented Session Protocol Specification - Addendum 2: Incorporation of Unlimited User Data, June 1988 (DIS)

ISO 8348, Information Processing Systems - Data Communications - Network Service Definition, First Edition, April 1987 (FINAL)

ISO 8348 AD 1, Information Processing Systems - Data Communications - Network Service Definition - Addendum 1: Connectionless Mode Transmission, First Edition, April 1987 (FINAL)

ISO 8348 AD 2, Information Processing Systems - Data Communications - Network Service Definition - Addendum 2: Network Layer Addressing, March 1988 (FINAL)

ISO 8348 DAD 3, Information Processing Systems - Data Communications - Network Service Definition - Addendum 3: Additional Features of the Network Service, April 1988 (FINAL)

ISO 8471, Data Communication - High-level Data Link Control Balanced Classes of Procedures - Data-link Layer Address Resolution/Negotiation in Switched Environments, First Edition, April 1987 (FINAL)

DIS 8473, Information Processing Systems - Data Communications - Protocol for Providing the Connectionless-Mode Network Service, May 1987 (DIS)

DIS 8473 PDAD 1, Information Processing Systems - Data Communications - Protocol for Providing the Connectionless-mode Network Service - Add 1: Provision of Underlying Service Assumed by ISO 8473 over Point-to-point Subnetworks which Provide the OSI Data Link Service, July 1987 (PDAD)

DIS 8473 PDAD 2, Information Processing Systems - Data Communications - Protocol for Providing the Connectionless-mode Network Service - Addendum 2: Formal Description of ISO 8473, Revised Edition, April 1988 (PDAD)

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APPENDIX D

BACKGROUND, OBJECTIVE, AND ADDITIONAL GUIDANCE

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BACKGROUND, OBJECTIVE, AND ADDITIONAL GUIDANCE

(U) This IDA Memorandum Report was written in response to Task Order T-J1-246 and Amendment No. 6. Those portions of the task order that pertain to the background and objectives of the task, and the additional guidance provided therein by the sponsoring office, are reprinted here.

2. <u>BACKGROUND:</u>

The tactical ADP portion of the NATO Long Term Defense Program (LTDP) proposed that command and control systems be built to common specifications. The Deputy SACEUR initiated a study to determine the feasibility of the nations in the Central Region commonly developing an Automated Army Tactical Command and Control Information System (ATCCIS) for deployment in the post-1995 timeframe. Commitments for supporting this effort were obtained from US, UK, and FRG Army Chiefs of Staff. These nations provided information on their operational doctrine, procedures, functions, and information exchange requirements for their maneuver forces, as well as their operational requirements for an automated CCIS and information on the ADP systems that they are currently developing to support their maneuver forces. This information was used in the initial phase of the study to determine the extent to which similarities and differences in national requirements for automated CCISs would indicate that a commonly developed system is potentially feasible. The results of this initial phase were positive. SHAPE has requested that their nations complete the study and has received US, UK and FRG Army Chiefs of Staff commitments.

3. OBJECTIVE:

The objective of this phase II effort of the study is to assist SHAPE in defining the military objectives and basic operational requirements for a common ATCCIS that achieves interoperability to ADP systems. The capabilities of ADP systems are to be compared to the concept of operations of each of the nations to determine the extent to which such a common ATCCIS could accommodate the requirements of each nation and to identify issues remaining to be resolved before such a system could be employed in the Central Region in post 1995 time period.

4. ADDITIONAL GUIDANCE:

The FY 1988 task includes:

a. Continue tasks to support the establishment of the organizational and operational concept, operational requirements, and technical concept for the ATCCIS.

b. Continue review of the U.S. operational doctrine, procedures, functions, and information exchange requirements for the maneuver forces and operational requirements for automated CCIS and the ADP systems currently being developed with a view towards post-1995 as necessary to conduct the study. This specifically includes efforts underway to develop and support dispersed command posts.

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GLOSSARY

ACBA	Allied Command Baltic Approaches
ACCIS	Automated Command and Control Information System
ACCS	Air Command and Control System
ACSE	Association Control Service Element
AD	Addendum (ISO)
ADSIA	Allied Data Systems Interoperability Agency
A-Dat-P	Allied Data Publication
AHMG	Ad Hoc Management Group (TSGCEE SG9)
AHWG	Ad Hoc Working Group
ANSI	American National Standards Institute
AR	U.S. Army Regulation
ASCE	Association Service Control Element (OSI)
ASN	Abstract Syntax Notation (OSI)
ATCCIS	Army Tactical Command and Control System
ATCCS	U.S. Army Tactical Command and Control System
ATOC	Allied Tactical Operations Center
ATP	Allied Tactical Publication
AWHQ	Alternate War Headquarters
B	ISDN B Service (64 kbit/second)
CAE	Common Applications Environment (X/OPEN)
CASE	Common Application Service Elements (OSI Layer 7)
CCIS	Command and Control Information System
CCITT	Comite Consultatif International de Telegraphique et Telephonique (International Telegraph and Telephone Consultative Committee)
CCR	Commitment, Concurrency, and Recovery (OSI)
CGM	Computer Graphics Metafile
CL	Connectionless (mode)
CLNP	Connectionless Network Protocol (OSI)
CO	Connection (mode)
COLOC	Change of Location of Command
CSMA/CD	Carrier Sense Multiple Access/Collision Detection
CSDN	Circuit Switched Data Network
CSN	Circuit Switched Network

D	ISDN D Service (16 kbit/second)
DAD	Draft Addendum (ISO)
DAFTG	Database Architecture Framework Task Group (ANSI)
DCE	Data Circuit-Terminating Equipment
DDL	Data Definition Language
DIS	Draft International Standard (ISO)
DMF	Data Management Facility (ATCCIS)
DML	Data Manipulation Language
DMRM	Data Management Reference Model
DP	Draft Proposal (ISO)
DTE	Data Terminal Equipment
DTR	Draft Technical Report (ISO)
ECMA	European Computer Manufacturers Association
FIPS	U.S. Federal Information Processing Standard
FORTRAN	Formula Translation (programming language)
FTAM	File Transfer, Access and Management (OSI Layer 7)
GAN	Global Area Network
GEADGE	German Air Defense Ground Environment
GKS	Graphics Kernel System
GOSIP	Government Open Systems Interconnection Profile
HDLC	High-Level Data Link Control (OSI Layer 2)
IEEE	Institute of Electrical and Electronics Engineers
INTAP	Interoperability Technology Association for Information Processing, Japan
IP	Internet Protocol; Interoperability Parameter
IRDS	Information Resource Dictionary System
ISAM	Indexed Sequential Access Method
ISDN	Integrated Services Digital Network
ISO	International Organization for Standardization
IUKADGE	Improved United Kingdom Air Defense Ground Environment
JTC	Joint Technical Committee
JTM	Job Transfer and Manipulation (OSI Layer 7)
LAN	Local Area Network
LLC	Logical Link Control (OSI Layer 3)

MCS	Maneuver Control System (U.S. Army)
MHS	Message Handling System (OSI Layer 7)
MMHS	Military Message Management System (see CCITT X.400-1988)
MOTIS	Message-Oriented Text Interchange System (OSI Layer 7)
MTA	Message Transfer Agent
N	Notice (ISO Working Paper)
NACISA	NATO Communications and Information Systems Agency
NAEW	NATO Airborne Early Warning
NBS	U.S. National Bureau of Standards (now NIST)
NBSIR	NBS Interim Report
NEC	Northern European Command
NFS	Network File Service
NIST	U.S. National Institute of Science and Technology
NDL	Network Database Language (OSI)
ODA	Office Document Architecture
ODIF	Office Document Interchange Format
OSF	Open Software Foundation
OSI	Open Systems Interconnection
PAD	Packet Assembly/Disassembly
PDAD	Preliminary Draft Addendum (ISO)
PDTR	Preliminary Draft Technical Report (ISO)
PDN	Public Data Network
PDU	Protocol-Data-Unit
PLP	Packet Level Protocol (X.25)
POSI	Promoting Conference for OSI
POSIX	Portable Operating System for Computer Environments
PRMD	Private Management Domain
PSC	Principle Systems Command
PSDN	Packet Switched Digital Network
PSTN	Public Switched Telephone Network
PWG	Permanent Working Group
QIP	Quadrilateral Interface Program
QTDMP	Quadrilateral Test and Demonstration Management Plan
QTIDP	Quadrilateral Technical Interface Design Plan
QTIR	Quadrilateral Technical Interface Requirements
RQCH	Remote Query/Cancel Handling (ATCCIS)
RDA	Remote Data Access (OSI)

ROS	Remote Operation Service (OSI)
ROSE	Remote Operation Service Element (OSI)
RTS	Reliable Transfer Service (OSI)
SC	Sub-committee (ISO); Study Committee
SCF	Service Control Facility
SDNS	Secure Data Network System (U.S. National Security Agency)
SGML	Standard Generalized Markup Language
SMF	System Management Facility (ATCCIS)
SPAG	Standards Promotion and Applications Group
SPARC	Standards and Planning Requirements Committee
SQL	Standard Query Language (ISO)
STAMINA	Standard Automated Message Processing Interface for NATO's ACCISs
STANAG	NATO Standardization Agreement
STN	Switched Telephone Network
STRIDA	Systeme de Traitement et de Representation des Informations de Defense Aerienne
SUCOC	Succession of Command
SVID	System V Interface Definition
SG	Sub-group
TADIL	Tactical Data Link
TCIS	Technical Common Interface Standards (TSGCEE SG-9)
TF	Transfer Facility (ATCCIS)
TIDP	Technical Interface Design Plan
TP	Transaction Processing (OSI)
TR	Technical Report (ISO)
TSGCEE	Tri-Service Group for Communications Electronic Equipment
UA	User Agent (OSI)
VTS	Virtual Terminal Service (OSI Layer 7)
WAN	Wide Area Network
WDAD	Working Draft Addendum (ISO)
WDAM	Working Draft Amendment (ISO)
WG	Working Group
WP	Working Paper (ATCCIS)
WWMCCS	World Wide Military Command and Control System

XID	Exchange Identification
XVS	X/OPEN System V Specification

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